

SIDA CONTRIBUTIONS TO BOTANY

VOLUME 10

NUMBER 1

APRIL 1983

CONTENTS

- Phylogenetic trees in plant systematics. *Tod F. Stuessy.* 1
- A new variety of *Dalea eriophylla* S. Wats. (Leguminosae-Amorpheae) from Sierra Madre Oriental. *R. C. Barneby.* 14
- The Sterculiaceae in the flora of the southeastern United States. *R. David Whetstone.* 15
- Application of the names *Verbesina mollis* and *Verbesina sericea* (Compositae: Heliantheae). *Neil A. Harriman.* 24
- The evolutionary origin of *Blumea viscosa* (Asteraceae) and a first report from North America. *Guy L. Nesom.* 30
- The taxonomic status of *Stipulicida filiformis* (Caryophyllaceae). *Walter S. Judd.* 33
- Eupatorium mohrii*, a new record for the Dominican Republic, including *E. quinqueflorum*, syn. nov. (Asteraceae). *Victoria I. Sullivan.* 37
- A systematic study of *Aster* section *Patentes* (Asteraceae). *Ronald L. Jones.* 41
- NOTES. Lectotypification of *Verbesina texana* Buckl. (Asteraceae): A Correction. 82
—Newly adventive grasses in the flora of Trinidad. 85—Rediscovery of *Hymenoxys texana* and notes on two other Texas endemics. 87—Range extensions for Cyperaceae in Louisiana and Texas. 92.
- REVIEW 92

US ISSN 0036-1488

SIDA, CONTRIBUTIONS TO BOTANY

Founded by Lloyd H. Shinnars, 1962

Publisher

Wm. F. Mahler
SMU Herbarium
Dallas, Texas, 75275

Associate Editor

John W. Thieret
Northern Kentucky University
Highland Heights, Kentucky, 41076

Editor

Barney L. Lipscomb
SMU Herbarium
Dallas, Texas, 75275

Guidelines for contributors are available upon request.

Subscription: \$10.00 (U.S.) per year; numbers issued twice a year.

©

Sida, Contributions to Botany, Volume 10, Number 1, pages 1–93.

Copyright 1983

by Wm. F. Mahler

PHYLOGENETIC TREES IN PLANT SYSTEMATICS

TOD F. STUESSY

Department of Botany, The Ohio State University, Columbus, OH 43210

ABSTRACT

Phylogenetic tree diagrams have been used for over a century to portray visually the estimated phylogeny of plant groups. These often accompany revisionary studies and usually summarize the classification and evolutionary relationships. Despite their widespread use, most trees do not show all possible relationships among the taxa, and frequently the relationships are shown in an ambiguous fashion. This hampers communication about the systematics of the group and makes comparisons of several different competing classifications for the same group difficult. A phylogenetic tree which shows all possible relationships is called a phylogram, and it contains information about (1) cladistics (branching patterns), (2) chronistics (time of divergence), (3) phenetics (over-all similarity and/or difference among extant taxa), and (4) patristics (total evolutionary change). Use of explicitly derived phylograms with high informational content in routine revisionary work is recommended. A method is presented for making a phylogram showing all four relationships using the genus *Lagascea* (Compositae) as a model.

Tree-like diagrams that represent the evolutionary history of groups of organisms, or phylogenetic trees, have been used for nearly a century in systematic biology (Voss, 1952). Ever since Darwin's (1859) *The Origin of Species by Means of Natural Selection*, phylogenetic trees have accompanied evolutionary studies to illustrate relationships. They have frequently been used with revisionary studies to summarize the affinities among taxa, especially within genera, and it is almost expected in modern work to find such diagrams. Phylogenetic trees not only summarize evolutionary information, but they also serve as stimuli for more detailed studies on the same groups. They provide visual inducement to test hypotheses of expressed relationships.

Despite widespread use of phylogenetic trees in plant systematics, many of the diagrams constructed have two faults: (1) the specific kinds of relationships or evolutionary information are not always clear; and (2) the manner in which the tree was constructed is usually not explicit. These differences hamper communication about the relationships expressed in the tree and also about the classification from which it is derived [e.g., Parenti's (1980) misinterpretation of certain aspects of Cronquist's (1960, 1966) system of classification of the land plants]. This becomes especially apparent in trying to compare different trees (or other tree-like diagrams) of the same group, e.g., of the angiosperms (Cronquist, 1968, 1981; Takhtajan, 1969; Stebbins, 1974; Dahlgren, 1975, 1977a, b; Thorne, 1976). These

problems interfere with resolving the differences among the diagrams (and classification) and do not serve as a proper stimulus for further work; in fact, an impasse often is reached.

The purposes of this paper, therefore, are to: (1) indicate clearly the different kinds of relationships that can be shown in a phylogeny; and (2) provide an example of an approach to developing a phylogeny of many relationships in the genus *Lagascea* (Compositae), which has been revised recently (Stuessy, 1978). A number of workers have touched on this subject previously (e.g., Lam, 1936; Sneath and Sokal, 1973; Sneath, 1974, 1975; Eldredge and Cracraft, 1980; Mayr, 1981; Nelson and Platnick, 1981). I believe, however, that a focused discussion on the positive effects of representing explicit relationships in phylogeny for the practicing plant systematist is needed at this time.

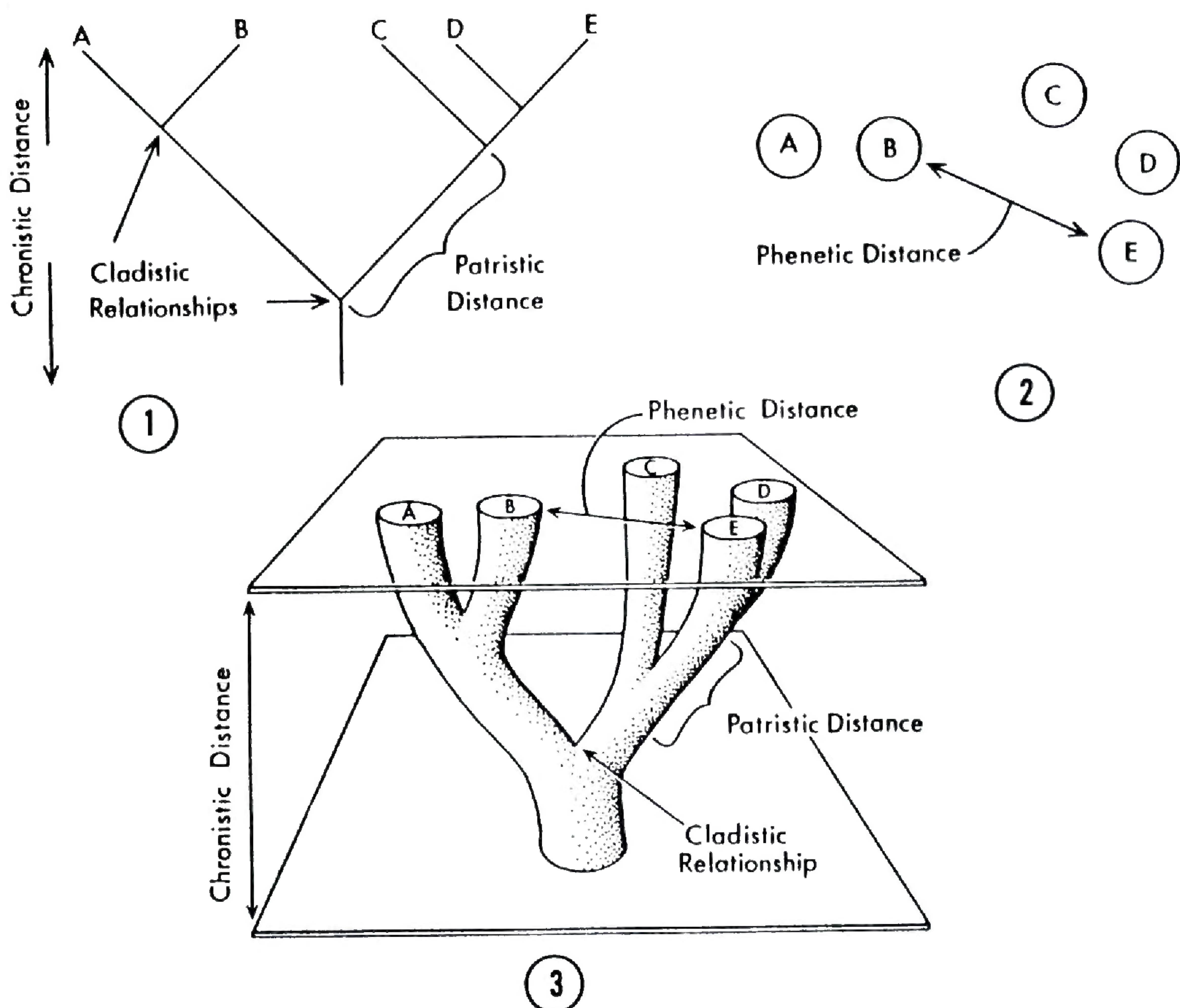
RELATIONSHIPS IN A PHYLOGENETIC TREE

To discuss the relationships that can be shown in a phylogenetic tree, it is important to stress that such tree diagrams have three dimensions¹. Within these three dimensions are represented four relationships: (1) chronistics; (2) cladistics; (3) patristics; and (4) phenetics.

CHRONISTICS.—The relationship of time is called chronistics. Obviously, all phylogenies have a time framework and this is measured usually in millions of years (Fig. 1). Time information can be derived directly from fossil evidence, or indirectly from extant distributional patterns. The former is self-evident, but the latter refers to vicariance events which can be explained by major geological alterations, for which geological age is known. Continental drift is a good example of this type of evidence which can help fix a time of origin (or splitting) of a lineage (cf. Nelson and Rosen, 1981, for many examples and perspectives).

CLADISTICS.—Cladistic relationships are the branching patterns of a phylogenetic tree, and therefore, are very important in any phylogenetic analysis (Fig. 1). This relationship, per se, says nothing about exactly where in geological time the branching took place, only that two (or sometimes more) lines diverge from a base of commonality of character states (primitive shared states for that line, but derived within the context of the entire tree; such derived states sometimes are called synapomorphies; Hennig, 1966). Cladistic relationships can be determined by many different manual or

¹ An effective, but unconventional and somewhat humorous, way to visualize a three-dimensional phylogenetic tree is to chop the flower buds off a fresh broccoli stem. The freshly cut terminal plane represents the present time and backwards down the stem successively younger phases of the phylogeny. Branching can be seen easily. For classroom use, one can actually ink the ends of the branches and press on blotter paper to get a view of phenetic relationships of present-day taxa. Successive planar cuts of the knife downward reveal the evolutionary appearance of the units and their relationships at earlier times.



Figs. 1-3. Diagrams showing relationships which can be expressed in an hypothetical phylogenetic tree (taxa A-E). Fig. 1, two-dimensional tree diagram showing chronistic, cladistic, and patristic relationships. 2, two-dimensional diagram showing phenetic relationships. 3, three-dimensional diagram (phylogram) combining chronistic, cladistic, patristic and phenetic relationships.

computer methods, but the two most common are those of parsimony and character compatibility (Funk and Stuessy, 1978). These all involve careful selection of characters and states (e.g., Crisci and Stuessy, 1980) and use of an algorithm (procedure) to actually draw the branching patterns.

PATRISTICS.—The patristic relationships are the total amounts of evolutionary changes along branches of the phylogenetic tree (Fig. 1). Cladistic relationships form the basis for determining patristic information, but in addition to the data of character state divergence due to splitting, are parallelisms and reversals that occur within each line (homoplasy; Simpson, 1961). In effect, the patristic relationships between taxa give additional relative indication of the degree of evolution within lineages, or whether some lines have evolved more rapidly than others. Cladistic and patristic

relationships, obviously, are closely tied together and the former analysis will be used to reveal the latter.

PHENETICS.—The phenetic relationship is the over-all similarity (or dissimilarity) of the taxa as we now would see them and intuitively assess their affinities (Sneath and Sokal, 1973). This can be diagrammed by envisioning we are looking at the end points of the lineage in the present time (Fig. 2) and the distance between these termini represents this over-all similarity. A number of methods can be used to develop this measure, but the most common are clustering and ordination (Sneath and Sokal, 1973). Because many characters are preferred for determining phenetic relationships (50 to 100), computers are usually employed to help with calculations.

These four relationships, chronistics, cladistics, patristics, and phenetics can all be represented on a single three-dimensional tree (called a "phylogram", Mayr, 1981; Fig. 3). This is the optimal situation in which information on all the four relationships is available. If all these data are not at hand, then at least the tree can be drawn to show clearly the relationships which are being incorporated (with clear and explicit figure legends). We are all familiar with the "diagrams showing evolutionary relationships" among taxa of certain groups, especially among species within genera that have been revised taxonomically, in which the dimensions or axes are unclear (e.g., Canne, 1977, her Fig. 7; Stuessy, 1977, his Fig. 1). Better would be for the relationships which were used to construct the phylogenetic tree to be stated more clearly (although sometimes this is difficult or impracticable). Another problem in tree construction, which has often occurred in the past, is that extant taxa are sometimes diagrammed as having given rise to other extant taxa (e.g., Takhtajan, 1969, his Fig. 31). This is simply "phylogenetic license" in tree construction, but it does make it impossible to show accurately chronistic and phenetic relationships (if known). Cladistic and patristic relationships, however, can still be shown accurately (e.g., see the phylogenetic tree for *Melampodium*; Stuessy, 1979, his Fig. 1). Such a phylogenetic tree is limited in communicating relationships and is better called a cladogram rather than a phylogram.

PHYLOGENY OF LAGASCEA (COMPOSITAE)

As an aid to understanding the concepts presented in the previous section of this paper, a phylogenetic tree of a small genus based on chronistic, cladistic, patristic and phenetic relationships will be constructed. The genus *Lagascea* Cav. (Compositae, Heliantheae) will be used for illustration. This taxon is a group of herbs and shrubs distributed almost exclusively along the Sierra Madre Occidental of Mexico (Stuessy, 1978). It is unusual within the Heliantheae in having secondary aggregations of unflowered capitula (Stuessy, 1976). These clusters are commonly surrounded by vegetative leaves which form a secondary involucre (the entire structure called a "syn-florescence"; Kunze, 1969). Stuessy (1978) in the most recent revision of

Lagascea recognized eight species grouped into three sections: Section *Lagascea*, *L. aurea* Stuessy, *L. mollis* Cav.; Section *Nocca*, *L. angustifolia* DC., *L. helianthifolia* H. B. K., *L. heteropappus* Hemsl., and *L. rigida* (Cav.) Stuessy; and Section *Calhounia*, *L. decipiens* Hemsl. and *L. palmeri* (Robins.) Robins. An intuitive phylogeny of the genus, incorporating explicit ideas on character evolution, was also presented. *Lagascea* is a good example to use in constructing a phylogenetic tree because: (1) it is a small, well-defined group; (2) the taxonomic relationships among the species and sections are clear and unambiguous; and (3) the genus *Alvordia*, used for outgroup comparisons, is well-understood (recently revised by Carter, 1964).

MATERIALS AND METHODS.—The characters used to determine phenetic and cladistic relationships in *Lagascea* were obtained primarily from the descriptions of species in the recent revision (Stuessy, 1978) with consultation of herbarium material (OS) where necessary for clarification. The quantitative data in the revision were described originally in terms of ranges of variation. For purposes here I used midpoints of the ranges to represent the states of all quantitative characters for each of the taxa. Maximum values were also used for comparison, but the results were the same and are not detailed here.

A total of 66 characters (18 vegetative and 48 reproductive) were used in assessing phenetic similarity. These characters are enumerated in Appendix I, along with the listing of each state, and the coding used in formulating the basic data matrix (Appendix II). The data matrix was analyzed using the BMDP computer program for factor analysis (P4M; Dixon and Brown, 1979).

In order to determine cladistic relationships within *Lagascea*, characters were selected for which it was possible to construct logical and unambiguous character state networks. Each network was then rooted by selecting the primitive character state of the network. The criterion used for determining which state was primitive was out-group comparison (Crisci and Stuessy, 1980), and *Alvordia* Brandg. was selected as the closest generic relative (Stuessy, 1976, 1977). The 16 characters used in the cladistic study, their states, and their numerical assignments are listed in Appendix I. Based on this information, which was incorporated into a basic data matrix (Appendix II), cladograms were formulated both manually (via Wagner Groundplan Divergence and Hennig-type methods; Mickel, 1962; Hennig, 1966; Wagner, 1980; Wiley, 1980) and with the Wagner 78 computer program (based on ideas in Farris, 1970).

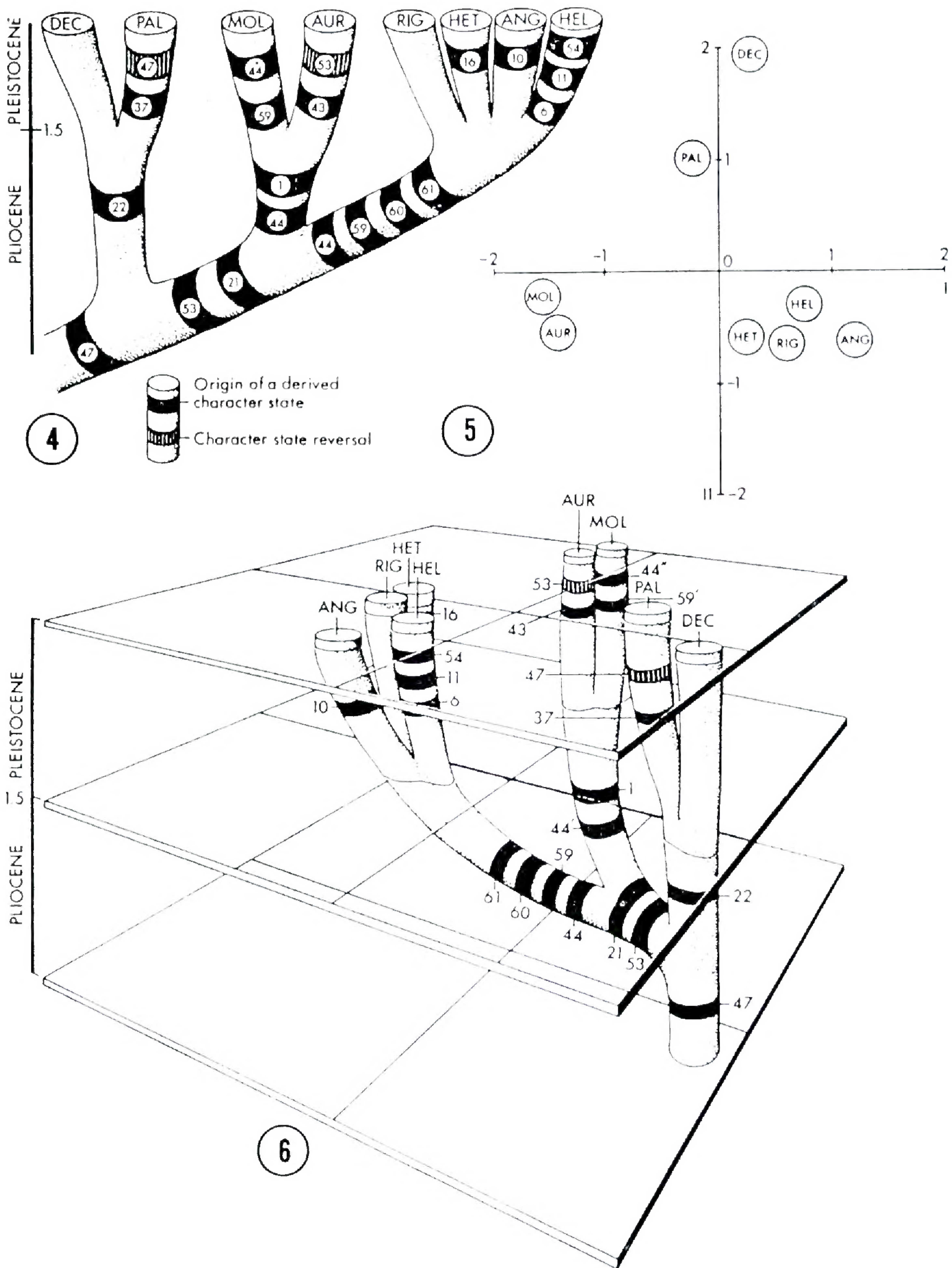
RESULTS.—The cladistic relationships of species of *Lagascea* are shown in Fig. 4. These branching patterns show clearly three main evolutionary lines which correspond to the previously recognized taxonomic sections. *Lagascea decipiens* and *L. palmeri* are shown to be closely related and these have been placed in Sect. *Calhounia*. These also show the fewest derived character state changes and may be regarded as the most primitive section

of the genus. *Lagascea mollis* and *L. aurea* form another distinct, but more advanced, evolutionary line. This corresponds with the previously recognized Sect. *Lagascea*. The four remaining species, *L. angustifolia*, *L. helianthifolia*, *L. heteropappus* and *L. rigida*, group together in the most advanced line and diverge from an unresolved tetrachotomy. These have been placed previously in Sect. *Nocca*. Three of the species (all but *L. helianthifolia*) are suspected of having been derived by adaptive radiation from within a broadly ranging taxon that was divided into three distinct populational systems, each eventually achieving specific status (Stuessy, 1978). The fourth species, *L. helianthifolia*, probably originated earlier and now has passed the test of sympatry (Mayr, 1942; Levin, 1971) by distributionally overlapping the related three taxa with only occasional hybridization (which happens due to breakdown in seasonal phenological isolation).

The patristic relationships are also shown in Fig. 4. The rings on the branches indicate changes in character states from primitive to derived conditions with no parallelisms and only two reversals (in characters 47 and 53). This is the most parsimonious tree that can be drawn from the data used. It becomes very clear that many features unite the sections within each of the lines, which are derived within the genus but primitive for the section. The branch leading to Sect. *Nocca* has more character state changes (4) than the rest, indicating that evolution has proceeded rapidly in this part of the phylogeny.

The chronistic relationships are also shown in Fig. 4 with the time dimension along the side of the tree. Because no mega- or micro-fossils are known for *Lagascea* (the entire fossil record of the family is still poorly understood; Crepet and Stuessy, 1978), the age of branch divergence must be determined by geological and/or distributional evidence. No data exist that help clarify the divergence of the pairs of species of Sects. *Calhounia* or *Lagascea*. Among the four species of Sect. *Nocca*, however, it is possible that *L. angustifolia*, *L. heteropappus*, and *L. rigida* were disrupted and isolated vicariously by the development of alluvial deposits of the Pliocene and Pleistocene in west-central Mexico (cf. Rzedowski, 1978; his Fig. 6 and Fig. 22 in Stuessy, 1978). If this were so (it is the only evidence presently available), then we might fix arbitrarily the age of divergence of these three species at about the Pleistocene-Pliocene boundary (1.5 million years ago). The age of divergence of the species in the other two lines cannot be determined independently, but the degree of cladistic (and phenetic, to be discussed below) distance between the pairs of species is comparable to that among the species of Sect. *Nocca*. It is unknown if the rate of character differentiation was the same (or at least similar) in each line, but we can arbitrarily fix the time of divergence for the species of these other lines at about the same point.

The phenetic relationships among species of *Lagascea*, as determined by factor analysis, is shown in Fig. 5. The three taxonomic sections stand out



Figs. 4-6. Cladistic, patristic, chronistic and phenetic relationships of *Lagascea*. Fig. 4, cladistic, patristic, and chronistic relationships. 5, phenetic relationships in a plot of the first two factors in factor analysis. 6, phylogenetic tree (phylogram) showing all four relationships. Arabic numerals in rings on branches in Figs. 4 and 6 refer to characters in which states have changed from primitive to derived conditions (or to reversals in 47 and 53). DEC = *L. decipiens*; PAL = *L. palmeri*; MOL = *L. mollis*; AUR = *L. aurea*; HEL = *L. helianthifolia*; RIG = *L. rigida*; HET = *L. heteropappus*; ANG = *L. angustifolia*.

clearly, and a close agreement exists with the results of the cladistic analysis. The distance in terms of over-all similarity² between any two taxa is shown, and the measure gives a good reflection of the way in which the species can be (and have been) differentiated and grouped intuitively. Another way of viewing this is how the diversity of *Lagascea* might appear to an observer in the present time plane (cf. broccoli model described earlier).

The cladistic, patristic, chronistic and phenetic relationships can be combined to produce a three-dimensional phylogenetic tree (phylogram) of *Lagascea* (Fig. 6). The phenetic relationships developed by factor analysis are used to determine the distance of the end points of the branches in the third dimension. The combination of phenetic and cladistic relationships in three dimensions gives a better visual representation of these parts of the phylogeny. This leads to a better understanding of the relative importance of these different measures of relationships for purposes of constructing a classification. In *Lagascea* a perfect graphic correlation exists between the cladistic and phenetic measures. In some groups this might not be the case, which would draw attention to the reasons for the differences.

CONCLUSION—The most important point of this paper is that the construction of phylogenetic trees can and should be done by explicit means. By determining the four relationships expressed in a phylogeny (cladistics, patristics, phenetics, and chronistics) and considering carefully how each can be graphically displayed, an increase in the communication of information about the final phylogeny occurs. Explicit methods and careful visual displays facilitate discussion about details of the phylogenetic reconstruction. Points of contention can more easily be addressed. In this fashion, the reconstructed tree serves as a greater stimulus for additional phylogenetic studies.

ACKNOWLEDGMENTS

Thanks go to: the Instructional and Research Computer Center of Ohio State University for computer time for the phenetic and cladistic analyses; students in Botany 810, Experimental Taxonomy, who provided helpful feedback on the ideas presented in this paper; David Dennis for drafting Figs. 1–7; NSF Grant DEB 75-20819 for financial support; and Michael Cichan and Vicki Funk for help with the early phases of the project.

REFERENCES

- CANNE, J. M. 1977. A revision of the genus *Galinsoga* (Compositae: Heliantheae). *Rhodora* 79: 319–389.

² One might question whether factor analysis represents over-all similarity in graphic display because suites of characters that account for maximum variation are selected and used for plotting of taxa on the coordinates. Nonetheless, the measure does begin with all characters and states and is routinely considered a phenetic technique (Sneath and Sokal, 1973; Clifford and Stephenson, 1975; McNeill, 1979). A clustering algorithm with two-dimensional graphic plot could also have been used here.

- CARTER, A. 1964. The genus *Alvordia* (Compositae) of Baja California, Mexico. Proc. Calif. Acad. Sci. 30: 157-174.
- CLIFFORD, H. T., and W. STEPHENSON. 1975. An introduction to numerical classification. Academic Press, N.Y.
- CREPET, W. L., and T. F. STUESSY. 1978. A reinvestigation of the fossil *Viguiera cronquistii* (Compositae). Brittonia 30: 483-491.
- CRISCI, J. V., and T. F. STUESSY. 1980. Determining primitive character states for phylogenetic reconstruction. Syst. Bot. 5: 112-135.
- CRONQUIST, A. 1960. The divisions and classes of plants. Bot. Rev. (Lancaster) 26: 425-482.
- . 1966. On the higher taxa of Embryobionta. Taxon 15: 129-134.
- . 1968. The evolution and classification of flowering plants. Houghton Mifflin Co., Boston.
- . 1981. An integrated system of classification of flowering plants. Columbia Univ. Press, N.Y.
- DAHLGREN, R. 1975. A system of classification of the angiosperms to be used to demonstrate the distribution of characters. Bot. Not. 128: 119-147.
- . 1977a. Ett angiospermschema och dess användning vid kartering av egenskaper. Svensk Bot. Tidskr. 71: 33-64.
- . 1977b. A commentary on a diagrammatic presentation of the angiosperms in relation to the distribution of character states. Plant Syst. Evolution Suppl. 1: 252-283.
- DARWIN, C. 1859. On the origin of species by means of natural selection. London.
- DIXON, W. J., and M. B. BROWN (eds.). 1979. BMDP-79: biomedical computer programs, P-series. Univ. Calif. Press, Berkeley.
- ELDREDGE, N., and J. CRACRAFT. 1980. Phylogenetic patterns and the evolutionary process: method and theory in comparative biology. Columbia Univ. Press, N.Y.
- FARRIS, J. S. 1970. Methods of computing Wagner trees. Syst. Zool. 19: 83-92.
- FUNK, V. A., and T. F. STUESSY. 1978. Cladistics for the practicing plant taxonomist. Syst. Bot. 3: 159-178.
- HENNIG, W. [transl. D. D. DAVIS and R. ZANGERL]. 1966. Phylogenetic systematics. Univ. Illinois Press, Urbana.
- KUNZE, H. 1969. Vergleichend-morphologische Untersuchungen an komplexen Compositen-Blütenständen. Beitr. Biol. Pflanzen 46: 97-154.
- LAM, H. J. 1936. Phylogenetic symbols, past and present. Acta Biotheor. 2: 155-194.
- LEVIN, D. A. 1971. The origin of reproductive isolating mechanisms in flowering plants. Taxon 20: 91-113.
- MAYR, E. 1942. Systematics and the origin of species. Columbia Univ. Press, N.Y.
- . 1981. Biological classification: toward a synthesis of opposing methodologies. Science 214: 510-516.
- McNEILL, J. 1979. Purposeful phenetics. Syst. Zool. 28: 465-482.
- MICKEL, J. T. 1962. A monographic study of the fern genus *Anemia*, subg. *Coptophyllum*. Iowa State Coll. J. Sci. 36: 349-383.
- NELSON, G., and N. PLATNICK. 1981. Systematics and biogeography: cladistics and vicariance. Columbia Univ. Press, N.Y.
- , and D. E. ROSEN. 1981. Vicariance biogeography: a critique. Columbia Univ. Press, N.Y.
- PARENTI, L. R. 1980. A phylogenetic analysis of the land plants. J. Linn. Soc. Biol. 13: 225-242.
- RZEDOWSKI, J. 1978. Vegetación de Mexico. Editorial Limusa, Mexico, D. F.
- SIMPSON, G. G. 1961. Principles of animal taxonomy. Columbia Univ. Press, N.Y.
- SNEATH, P. H. A. 1974. Phylogeny of microorganisms. Symp. Soc. Gen. Microbiol. 24:1-39.

- . 1975. Cladistic representation of reticulate evolution. *Syst. Zool.* 24: 360–368.
- , and R. R. SOKAL. 1973. Principles of numerical classification. W. H. Freeman, San Francisco.
- STEBBINS, G. L. 1974. Flowering plants: evolution above the species level. Harvard Univ. Press, Cambridge.
- STUESSY, T. F. 1976. A systematic review of the subtribe Lagasceinae (Compositae, Helianthaceae). *Amer. J. Bot.* 63: 1289–1294.
- . 1977. Heliantheae—systematic review, pp. 621–671. *In*, V. H. Heywood, J. B. Harborne, and B. L. Turner (eds.), *The Biology and Chemistry of the Compositae*. Academic Press, London.
- . 1978. Revision of *Lagascea* (Compositae, Heliantheae). *Fieldiana Bot.* 38: 75–133.
- . 1979. Cladistics of *Melampodium* (Compositae). *Taxon* 28: 179–195.
- TAKHTAJAN, A. [transl. C. JEFFREY]. 1969. Flowering plants: origin and dispersal. Oliver & Boyd, Edinburgh.
- THORNE, R. F. 1976. A phylogenetic classification of the Angiospermae, *Evol. Biol.* 9: 35–106.
- VOSS, E. G. 1952. The history of keys and phylogenetic trees in systematic biology. *J. Sci. Lab. Denison Univ.* 43(1): 1–25.
- WAGNER, W. H., Jr. 1980. Origin and philosophy of the Groundplan-divergence method of cladistics. *Syst. Bot.* 5: 173–193.
- WILEY, E. O. 1980. Phylogenetic systematics and vicariance biogeography. *Syst. Bot.* 5: 194–220.

Appendix I. Characters and states of species of *Lagascea* used in the phenetic and cladistic analyses. All characters (except #6) were used for the phenetic analysis; characters in small capitals are those used also in the cladistic analysis, in which case 0 = primitive and 1 (or 2 and 3) = derived. All quantitative measurements are in mm unless stated otherwise.

1; HABIT, shrub (0), herb (1). 2, PLANT HEIGHT (m). 3, STEM Diam; 4, Color, yellow (0), green to gray (1); 5, Vesture, subglabrous to glabrous (0), pilose, hirtellous or strigose (1), sericeous (2). 6, LEAVES, petiolate (0), sessile (1). 7, PETIOLE LENGTH; 8, Diam; 9, Vesture, absent (0), ciliate or hirtellous (1). 10, BLADE SHAPE, ovate to narrowly ovate (0), lanceolate to oblanceolate (1); 11, LENGTH (cm); 12, Width (cm); 13, Apex, acute (0), acute-acuminate (1), acuminate (2); 14, Base, attenuate (0), attenuate-obtuse (1), obtuse to subauriculate (2); 15, Margin, subentire-serrate (0), serrate or serrate-dentate (1); 16 VESTURE (ABAXIAL), glabrous to subglabrous (0), strigose to tomentose (1), sericeous (2) [for cladistics the 1st 2 states coded as 0 and 2 as 1]; 17, Vesture (abaxial) Length; 18, Vesture (adaxial), as in 16; 19, Vesture (adaxial) Length. 20, SYNFLORISCENCE Number of Heads; 21, FLORETS/HEAD, sometimes 2-many (0), always 1 (1); 22, ARRANGEMENT, campanulate (0), globose (1); 23, Height (cm); 24, Diam (cm). 25, PEDUNCLE Length; 26, Diam; 27, Vesture, glabrous (0), strigose (1), sericeous (2), stipitate-glandular (3); 28, Vesture Length; 29, RECEPTACLE Diam; 30, Height; 31, Vesture, subglabrous (0), pubescent, hirtellous or pilose (1); 32, Vesture Length. 33, SECONDARY PHYLLARY Number; 34, Shape, lanceolate (0), lanceolate-ovate (1), lanceolate-obovate (2); 35, Length; 36, width; 37, VESTURE (ABAXIAL), strigose or pilose (0), stipitate-glandular (1), glabrous or subglabrous (2), [for cladistics the first 2 states coded as 0 and the third as 1]; 38, Vesture (abaxial) Length; 39, Vesture (adaxial), as in 37; 40, Vesture (adaxial) Length. 41, PRIMARY INVOLUCRE Length; 42, Diam; 43, NUMBER OF PHYLLARIES

[for cladistics 4–5 as 0, 6 as 1]; 44, NUMBER OF GLANDS/PHYLLARY [for cladistics 1 large gland (0), 3 medium glands in 1 row (1), more than 3 glands in 1 row (2), more than 3 glands each in 2–3 rows (3) *]; 45, Number of Rows of Glands; 46, Gland Length; 47, VESTURE (ABAXIAL), glabrous or subglabrous (0), strigose to pilose (1); 48, Vesture (abaxial) Length; 49, Vesture (adaxial), as in 47; 50, Lobe Length; 51, Lobe Width (base); 52, Apex, acute (0), acuminate (1). 53, COROLLA COLOR, yellow (0), pink or white (1); 54, THROAT LENGTH [for cladistics 2.8–5 mm (0), > 5 (1)]; 55, Throat Diam; 56, Lobe Length; 57, Tube Length; 58, Tube Diam. 59, ANTHHER COLOR, yellow (0), brown or black (1) [for cladistics brown (1), black (2) **]; 60, LENGTH [for cladistics 2–3 mm (0), 4.5–5 (1)]. 61, STYLE LENGTH [for cladistics 5–8 mm (0), 15–18 (1)]. 62, ACHENE Shape, cylindrical (0), obovate (1); 63, Length; 64, Diam. 65, PAPPUS Type, erose crown (0), awns (1); 66, Length.

* The character state tree for this character shows 0 giving rise to 1 in one direction and 2 and 3 sequentially in the other.
** The character state tree has 0 giving rise to 1 in one direction and 2 independently in the other.

Appendix II. Basic Data Matrix of states of characters in species and sections of *Lagascea*. See Appendix I for descriptors and numerical assignments of characters and states. If phenetic differs from cladistic coding, fractions are given with numerator the former and denominator the latter. Characters used for cladistic analysis italicized (these were also used for phenetic analysis, except for #6).

CHARACTERS	TAXA							
	Sect. <i>Lagascea</i>		Sect. <i>Nocca</i>			Sect. <i>Calhounia</i>		
	1. <i>L. mollis</i> Cav.	2. <i>L. aurea</i> Stuessy	3. <i>L. helianthifolia</i> H. B. K.	4. <i>L. rigida</i> (Cav.) Stuessy	5. <i>L. heteropappus</i> Hemsl.	6. <i>L. angustifolia</i> DC.	7. <i>L. decipiens</i> Hemsl.	8. <i>L. palmeri</i> (Robins.) Robins.
1	1	1	0	0	0	0	0	0
2	1	1	3	2	2	1.5	3	3
3	5	4.5	20	18	12	14	12	15
4	0	0	1	1	1	1	1	1
5	0	1	1	0	2	1	0	0
6	0	0	1	0	0	0	0	0
7	16	17.5	0	5	7	9.5	9	11
8	0.5	0.7	0	2	1.5	1.5	0.7	1
9	1	1	0	0	0	0	0	0
10	0	0	0	0	0	1	0	0
11	5.7	3.8	23.5	7.2	6.8	6.3	2.9	6.5
12	3.2	2.5	8.3	4.1	2.6	2.1	3.7	2.6

Appendix II. Continued

CHARACTERS	TAXA							
	1	2	3	4	5	6	7	8
13	1	1	1	0	0	0	2	2
14	1	1	2	1	1	0	1	1
15	0	0	1	0	0	0	1	1
16	1/0	1/0	1/0	1/0	2/1	1/0	1/0	0
17	0.4	0.9	0.4	0.05	1	1	0.1	0
18	1	1	1	1	1	1	1	0
19	0.4	0.9	0.7	0.05	0.2	1	0.1	0
20	16.5	11.5	26	15	11.5	13	32	34
21	1	1	1	1	1	1	0	0
22	0	0	0	0	0	0	1	1
23	1.1	1.2	2.3	2.1	1.8	2.1	2.9	1.9
24	1.9	1.2	2.3	2.1	1.8	2	4	2.5
25	4.4	2.4	0.6	1.9	0.5	1.9	3	4
26	0.9	0.6	1.5	1.5	1.8	1	0.7	0.8
27	3	1	3	3	2	3	3	0
28	0.4	0.5	2	0.7	1	2	0.1	0
29	2	1.3	3.5	2.5	2.3	1.5	1.5	2
30	1.2	1	1.8	0.5	1.2	0.4	1	1.4
31	1	1	0	0	0	1	0	0
32	0.3	0.3	0	0	0	0	0	0
33	5	5	5.5	6	5	5	5	7
34	2	2	1	0	0	1	0	1
35	10	10	24	16.5	10	11	12.5	22.5
36	3.5	5.3	8	4.3	3.8	3.5	3	9.5
37	1/0	0	1/0	1/0	0	0	0	2/1
38	0.3	0.5	0.3	0.3	1	0.5	0.6	0
39	2	1	1	2	0	0	1	0
40	0.3	0.5	0.3	0.3	0	0	0.6	0
41	4.5	4.4	8	6.8	7.4	8.6	11	7
42	1	1.1	1.3	1.4	1.5	1	1.2	1.5
43	4.5/0	6/1	5/0	5/0	5/0	4.5/0	5/0	5/0
44	6.5/3	6/2	2.5/1	2.5/1	2.5/1	2/1	1/0	1/0
45	2.5	1	1	1	1	1	1	1
46	0.3	0.3	1.5	1	0.9	1.5	3	3
47	1	1	1	1	1	1	1	0
48	0.3	0.3	4	2	2.5	3.3	1	1
49	0	1	1	1	1	1	1	1
50	1.4	1.5	3.2	2.4	1.5	2.8	2.5	1.6
51	0.8	0.3	0.7	0.7	0.6	0.8	0.5	0.6
52	1	1	1	1	1	1	1	0
53	1	0	1	1	1	1	0	0
54	3/0	2.8/0	7.5/1	4.5/0	4.5/0	4/0	4/0	5/0
55	0.6	0.7	1.5	1.5	1.5	2.5	1.4	1.2
56	1.5	1.9	2.5	2.4	2.5	2.9	1.5	1.5
57	0.6	0.7	3.5	3.3	4.5	4.5	1	0.7
58	0.3	0.3	0.7	0.4	1.3	0.3	0.5	0.5
59	1/2	0	1	1	1	1	0	0
60	2/0	3/0	5.5/1	5/1	4.5/1	4.5/1	3/0	3/0
61	5/0	7/0	17.5/1	16/1	15/1	16.5/1	8/0	5/0
62	1	1	1	1	1	1	0	0

Appendix II. Continued
TAXA

CHARACTERS	1	2	3	4	5	6	7	8
63	3	2.8	5.5	4	3.3	4.5	3	3
64	1.2	1.1	1.2	1.2	1.3	1.3	0.8	0.5
65	0	0	1	1	1	1	0	0
66	0.2	0.3	0.5	1.8	1	0.8	0.1	0.2

A NEW VARIETY OF *DALEA ERIOPHYLLA*
S. WATS. (LEGUMINOSAE-AMORPHEAE)
FROM SIERRA MADRE ORIENTAL

R. C. BARNEBY

New York Botanical Garden
Bronx, NY 10458

DALEA ERIOPHYLLA S. Wats. var. **uniflora** Barneby, var. nov.

Ab aliis speciei varietatibus floribus solitariis, ulterius a var. *eriophylla* quoad pubem congrua foliolis angustissime oblanceolatis involutis 0.5–0.7 mm tantum latis, a var. *frankenioide* Barneby quoad foliolorum ambitu comparabili foliis utrinque stipulisque extus (nec intus) canescenti-tomentellis recedens.

In my revision of *Dalea* (1977, p. 459) I called attention to a sterile specimen (*Shreve & Tinkham* 9737, GH) that differed from other known examples of *D. eriophylla* in linear-oblanceolate (not broadly oblanceolate or obovate) tightly involute leaflets. By courtesy of Dr. B. L. Turner I now have before me two flowering specimens with similar foliage which differ further from normal *D. eriophylla* in having the terminal capitulum reduced to a single flower. In outline of leaflets, these plants, here segregated as var. *uniflora*, resemble var. *frankenioides*, which is known only from the neighborhood of Catorce in San Luis Potosí, about 130 km to the southwest of Ascensión. The latter remains, however, obviously distinct even without flowers in its vivid green glabrous leaflets and externally hairless castaneous stipules that contrast with gray-tomentellous internodes.

TYPE: MEXICO. NUEVO LEÓN: open pine slope 4 mi S of Pablillo, 20 Jul 1958 (fl), *D. S. Correll & I. M. Johnston* 19903 (HOLOTYPUS: LL).

Open pinewoods near 2100–2200 m, known only from the segment of Sa. Madre Oriental lying along the 100th meridian between 24°20' and 24°40' N lat. in S Nuevo León.

Additional collections examined: Nuevo León: N of Doctor Arroyo near 100°W, 24° 30' N, *Vankat* 96 (TEX).

REFERENCES

BARNEBY, R. C. 1977. *Daleae* Images, Mem. New York Bot. Gard. 27: 1–891.

THE STERCULIACEAE IN THE FLORA OF THE SOUTHEASTERN UNITED STATES¹

R. DAVID WHETSTONE

*Herbarium, Department of Biology, Jacksonville State University
Jacksonville, AL 36265*

ABSTRACT

The Sterculiaceae is represented in the southeastern flora by four genera and seven species which grow without cultivation. Distribution in the flora area is primarily in the warmer portions, mostly in the Coastal Plain Province. Taxa are highly polymorphic yet are well marked species in our range.

The Sterculiaceae in the southeastern flora is comprised of four genera and seven species which grow without cultivation. The family is primarily tropical and subtropical. Most commonly, those members in our range are restricted to the warmer portions, reaching their northern or near northernmost limits in our area. Most taxa are widely distributed in the Caribbean and in other parts of the neotropics. Some are introductions which are known sporadically in our area or as waifs in the northern limits of their range. Taxa are extremely polymorphic although our taxa are well-marked at the species level.

Descriptions and other data are based upon measurements and other observations on specimens collected within the southeastern states. Specimens studied are housed in the following herbaria: CITA, CM, CU, FLAS, FSU, GH, JSU (Jacksonville State University Herbarium, IAPT acronym, ined.), LSU, LTU, MARY, MO, NCU, NLU, NO, NY, SMU, TENN, TEX, UARK, UG, UNA, US, USF, VDB, VSC, and WVA. Documented county distribution in the area is depicted by accompanying maps.

SYSTEMATICS

Monoclinous or diclinous trees, shrubs, subshrubs and herbs; pubescence of stellate, forked, or simple unbranched hairs. Leaves simple, alternate, palmately veined, stipulate, and petiolate. Inflorescences determinate as thyrses or cymes, sometimes compact. Flowers monomorphic or dimorphic, perianth pentamerous, some apetalous; staminal tube present in most. Fruits primarily capsules with variable dehiscence but mostly schizocarpic. Many taxa closely

¹ Prepared from data obtained during the preparation of the treatment of the Sterculiaceae for the "Vascular flora of the Southeastern United States." The systematics section is similar in format to that outlined in Radford et al. (1967). Comments regarding the improvement of this manuscript will be greatly appreciated. Commentary should be forwarded to the author prior to publication of the volume.

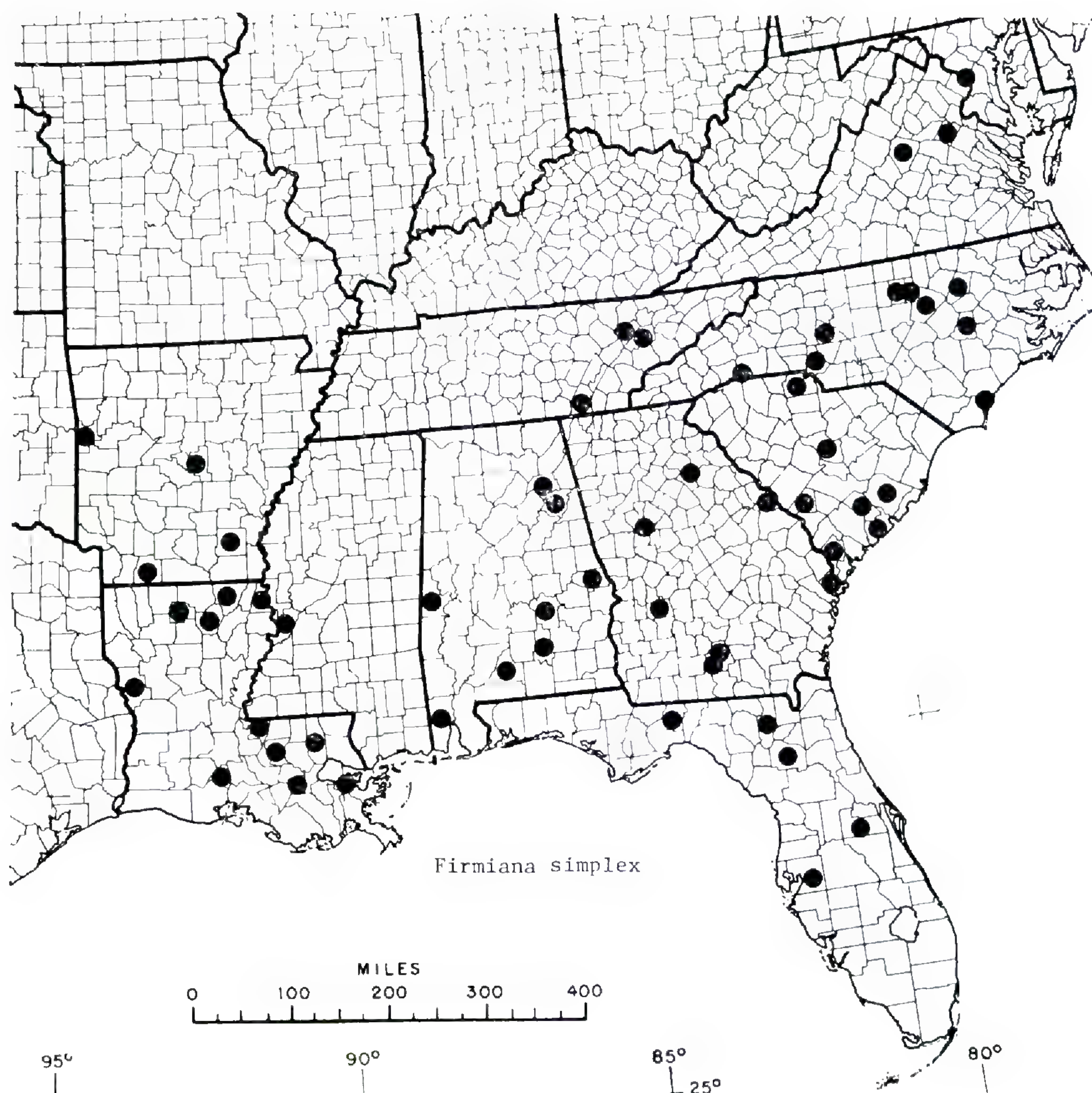
resemble and are frequently mistaken for members of Malvaceae. In our taxa, the stamen number is 5 (except *Firmiana*), whereas Malvaceae has stamens numerous.

About 60 genera and 700 species, distributed mostly in the tropics and subtropics (Willis 1973). Economically important members are *Cola* spp. and *Theobroma* (cacao). Buettneriaceae—S. Brizicky, G. K. 1966. The genera of Sterculiaceae in the southeastern United States. J. Arnold Arbor. 47: 60–74.

1. Trees; petals wanting; fruits follicles (phylloid) 1. *Firmiana*
1. Shrubs, subshrubs, or herbs; petals present; fruits capsules or legumes
 2. Flowers solitary from leaf axils; petals with apical, abaxial appendage 2. *Ayenia*
 2. Flowers in cymose or capitate inflorescences; petals lacking apical, abaxial appendage
 3. Gynoecium unicarpellate; styles eccentric 3. *Waltheria*
 3. Gynoecium 5-carpellate; styles epicentric 4. *Melochia*

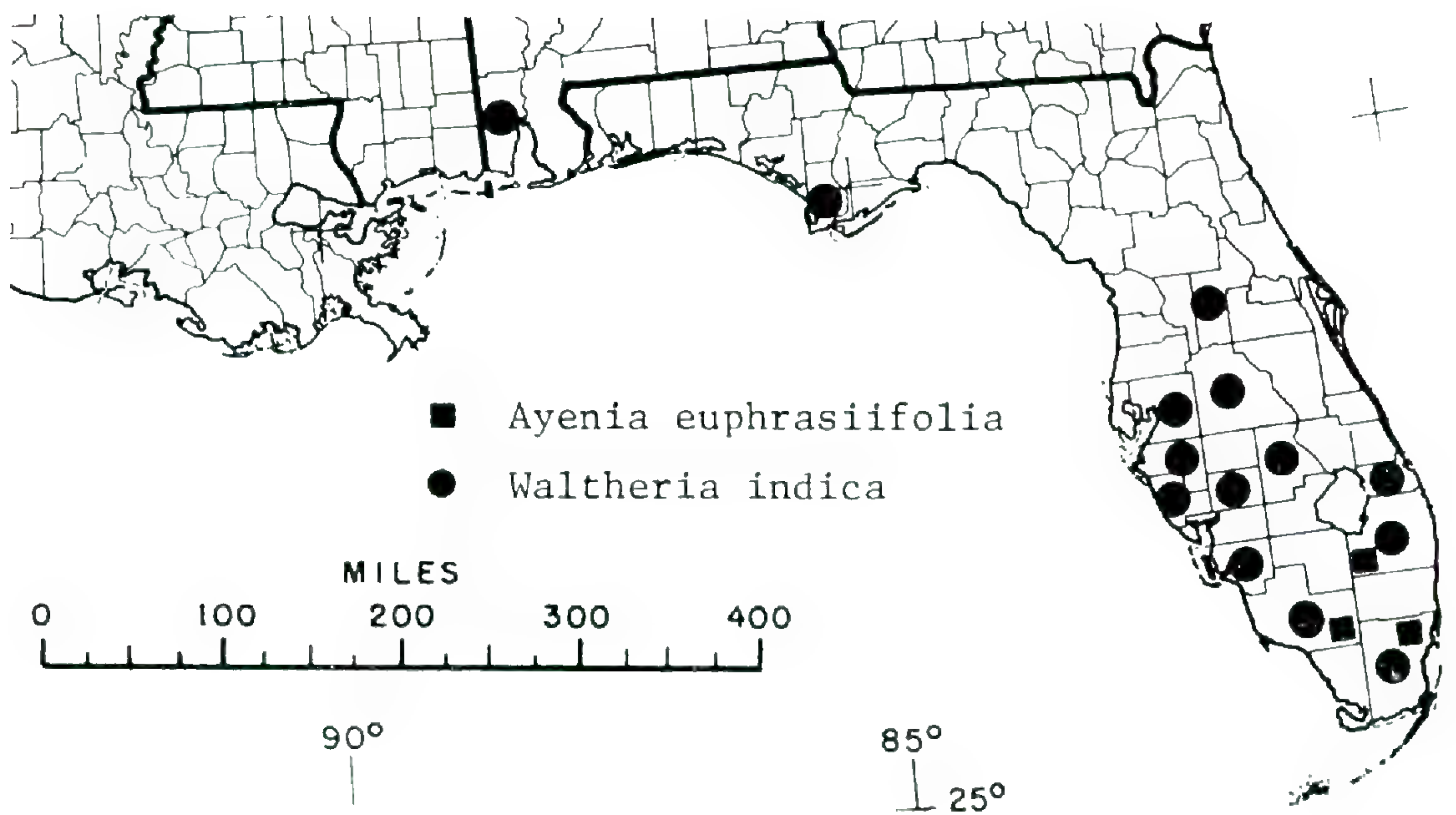
1. FIRMIANA Marsili

1. F. SIMPLEX (L.) Wight, Chinese Parasol Tree or Phoenix Tree—Small, monoecious trees. Twigs stout, green, buds with chocolate brown stellate pubescence. Leaves deciduous; blades palmately 3 to 5 (7) lobed, 8–40 cm, about as long as broad, minutely stellate pubescent above and below, glabrate above, apices along acuminate, margins cleft, lobes entire, bases cordate to rounded; petioles equaling or exceeding the blade; stipules caducous. Inflorescences axillary or terminal thyrses to 5 dm long; pedicels about 5 mm long, jointed above the middle. Flowers imperfect, actinomorphic, calyx tube cupuliform with a dense band of hairs and nectariferous disk surrounding the androgynophore, lobes to 10 mm long (greatly exceeding the tube), reflexed, somewhat darkened adaxially near the base; petals wanting; stamens (10) 15 forming a globular clump concealing the pistillodes, stamens in pistillate flowers sessile to subsessile on a subtending ring; gynoecium 5-carpellate, connivent below, styles connate. Follicles membranous, stipitate, 2–4 seeded, phylloid. Seeds orbicular, ca 6 mm broad, rugose; placentation marginal. ($2n = 40$) Summer. *F. platanifolia* (L.) R. Brown—S. *F. platanifolia* (L.f.) Marsili—R. Native to southeast Asia, probably China. Widely cultivated across the SE, often becoming locally established in the vicinity of planted trees. Often information is not present on herbarium specimens that indicate whether collections are from cultivation or from naturalized populations. Seedlings and transgressives have survived numerous winters in the Valley and Ridge Section of Alabama (personal observations). The maps include all localities from which vouchers were made. Juvenile leaves resemble those of *Aleurites fordii* Hemsley, yet lack the large glands at the junction of the petiole and blade. Kostermans, A.J.G.H. 1957. The genus *Firmiana* (Sterculiaceae). Reinwardtia 4: 281–310.



2. AYENIA L.

1. *A. EUPHRASIOFOLIA* Grisebach, Dwarf Ayenia—Perennial herbs and subshrubs. Taproots long, tough. Caudex broadly expanded with a whorled stubble of aerial stem bases; aerial stems prostrate, wiry, reddish-brown, 11–40 cm long, indumentum of stellate pubescence. Leaf blades orbicular to ovate, 0.4–1.4 cm long, surfaces reddish-brown mottled, venation palmate (evident below), pubescence stellate, apices cuspidate, margins dentate with bristle tips, bases (rounded) truncate to cordate; petioles 2–3 mm long; stipules subulate, caducous. Flowers solitary from axils of upper leaves, perfect, actinomorphic; calyx basally connate, lobes lanceolate to elliptic, about 1.8 mm long; petals reddish, rhombic, apically adnate to the staminal tube, ca 6 mm long, apices emarginate to cleft with an abaxial appendage,



bases long clawed; androgynophore 2.2–3 mm long, glabrous; stamen filaments connate for most of length; gynoecium 5-carpellate, less than 0.5 mm long, ovary ovoid, styles 1 with a capitate stigma slightly exerted from the androecium; pedicellate. Capsules septicidal and loculicidal, turgid, 4–5 mm broad, muricate with stellate bristles-tipped tubercles. Seeds 1 per locule, slightly conical, warty, brown with reddish glands. Year round. Pinelands, sandy scrub, rock flats, savannahs and waste places; CP: subtropical FL. *A. euphrasiifolia* Grisebach, *A. pusilla* L.—S. *A. pusilla* was reported by Chapman (1884) and Small (1933), however, this species is South America in distribution. All specimens of "*A. pusilla*" at NY from Florida were annotated by Cristobal as *A. euphrasiifolia*. Cristobal, C. L. 1960. Revision del genero *Ayenia* (Sterculiaceae). Opera Lilloana 4: 1–230.

3. WALTHERIA L.

1. *W. INDICA* L.—Monoclinous, perennial, fruticose herbs or small shrubs; stems single or multi-stemmed to about 1.5 m. Taproot thick. Leaves deciduous, blades ovate, 1.5–6 (10) cm long, densely stellate pubescent, apices acute, margins dentate, bases cordate (truncate); petioles $1/4$ – $1/3$ the blade length; stipules subulate, caducous. Inflorescences capitate cymes, somewhat secund, terminal and/or axillary from upper leaves, subsessile or on peduncles to 3 cm long, outer bracts ovate, involucrate, inner bracts lanceolate. Flowers perfect, calyx flattened adaxially, slightly zygomorphic, to 3.7 mm long, tube strongly 10-nerved; lobes 1.5 mm long, apices long acuminate; corolla yellow, rotate, petals spatulate apically, clawed basally; staminal tube basally adnate to the corolla; ovary unicarpellate, stellate pubescent on the top half, styles eccentric, stigmas fimbriate; pedicels wanting. Legumes 1 (2)

seeded; seeds brown, 1.2 mm long. ($2n=14$) Year round. Hammocks, pine-lands, and disturbed areas in sandy or rocky soils; CP: AL and FL [TX]. *W. americana* L.—S. Primarily distributed in south Fla, although reported along the northern Gulf Coast at Appalachicola, FL, and Mobile, AL, as apparent adventives.

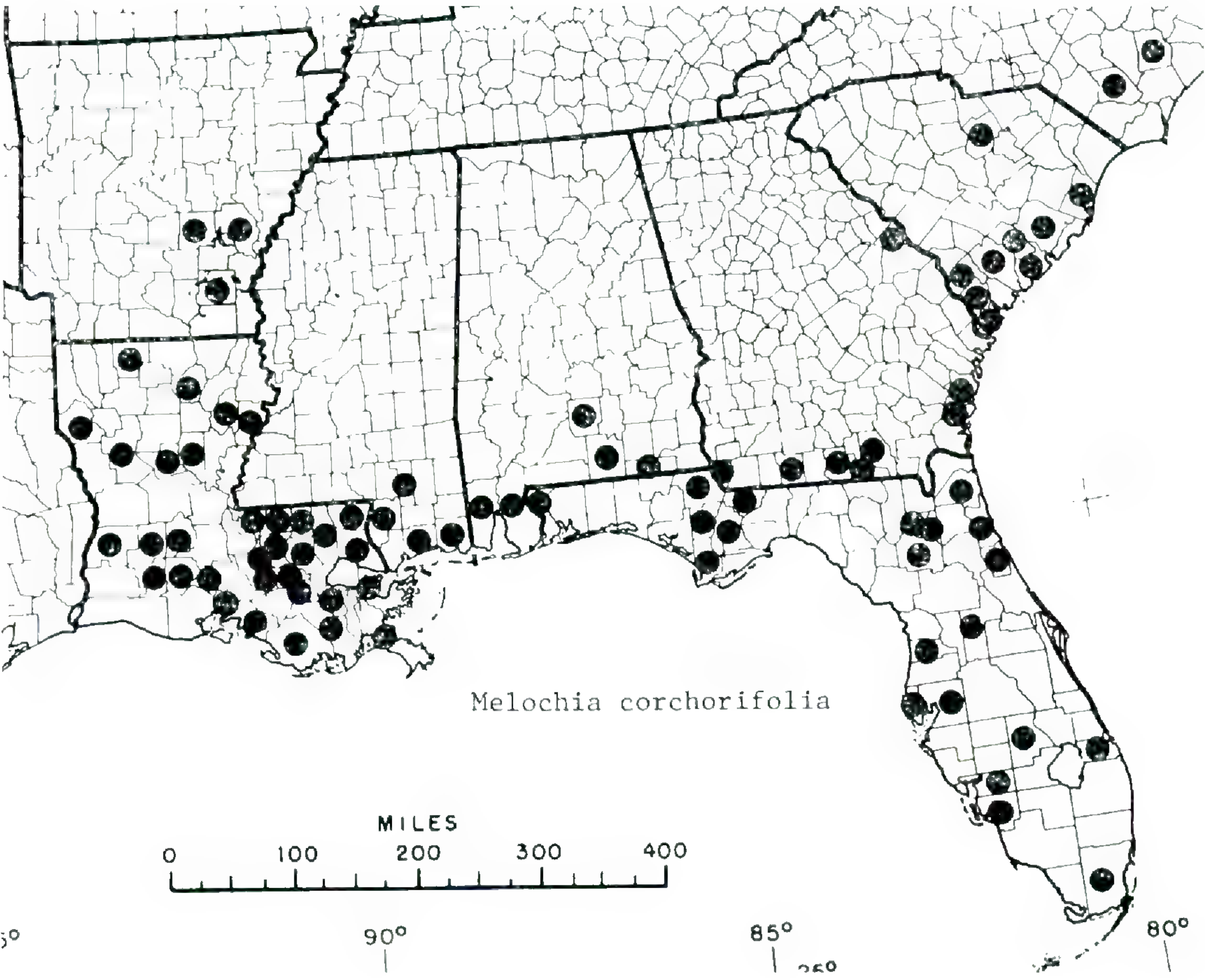
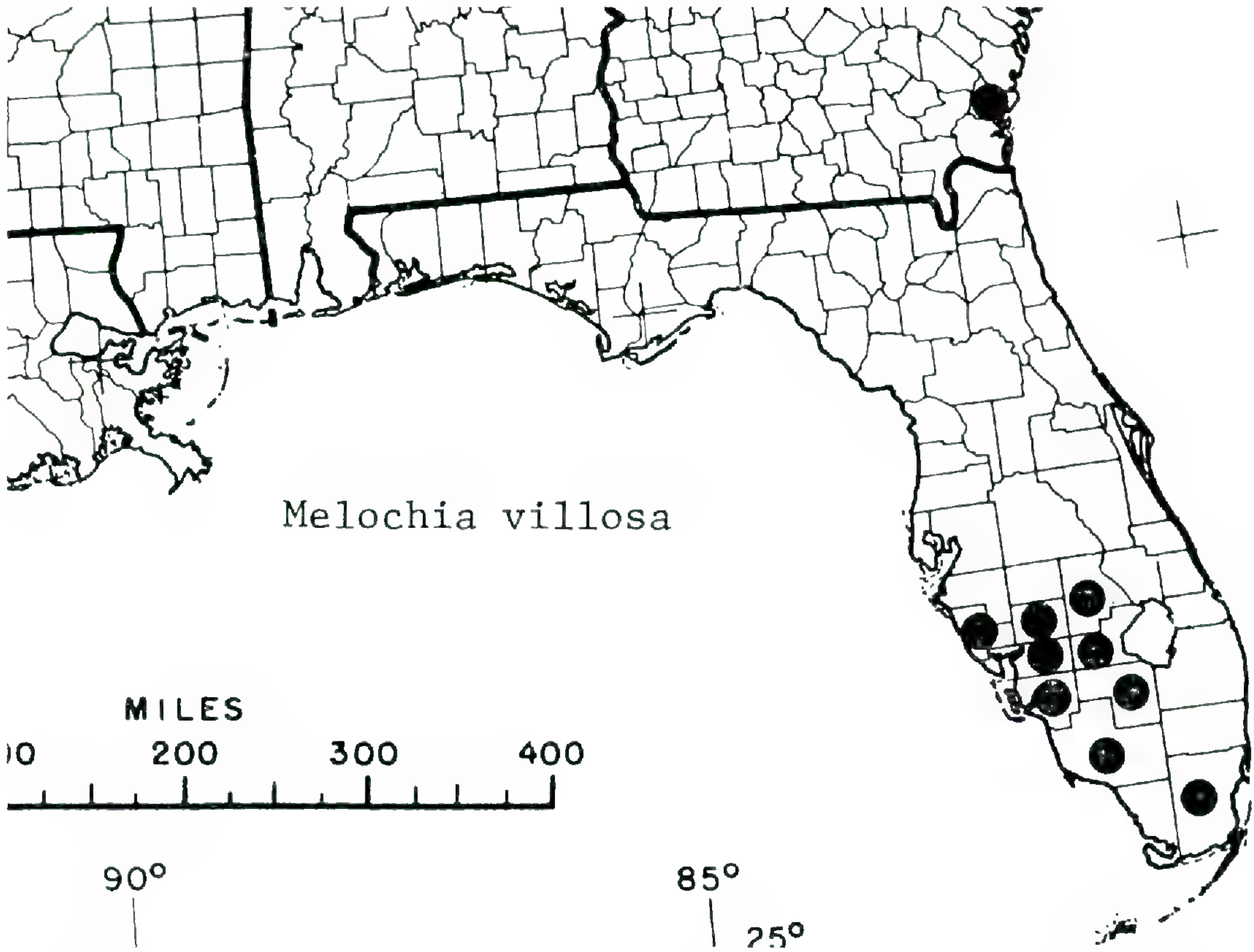
4. MELOCHIA L. Broom-wood

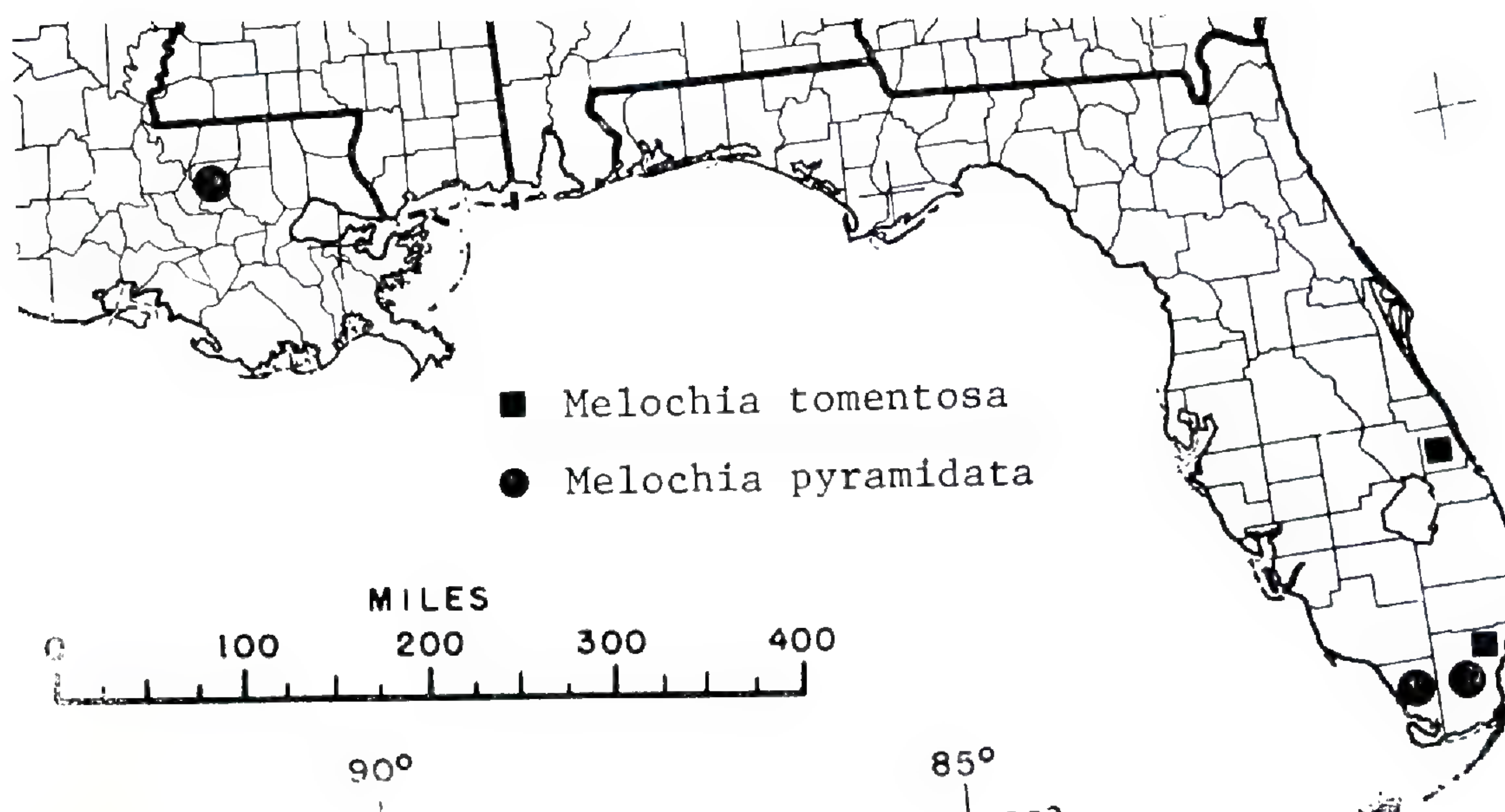
Annual or perennial herbs, shrubs, or subshrubs with stellate to unbranched pubescence. Taproots long, tough. Stems erect to sprawling. Leaf venation palmate, sometimes obscurely so; stipules caducous. Inflorescences cymose, terminal or axillary. Flowers perfect, actinomorphic, tetracyclic, pentamerous, dimorphic in some; stamen filaments basically connate. Fruits capsular. Goldberg, A. 1967. The genus *Melochia* L. (Sterculiaceae). Contr. U.S. Natl. Herb. 34: 191–363.

1. Involucel of 3+ bractlets; capsules subglobose.
 2. Inflorescences spicate; capsules less than 3.5 mm long..... 1. *M. villosa*
 2. Inflorescences terminal on primary or lateral branches; capsules ca 5 mm long 2. *M. corchorifolia*
1. Involucel wanting; capsules pyramidal.
 3. Leaves tomentose; capsules densely stellate pubescent..... 3. *M. tomentosa*
 3. Leaves essentially glabrous; capsules sparsely pubescent, ciliate along the veins 4. *M. pyramidata*

1. *M. VILLOSA* (Miller) Fawcett & Rendle. Suffrutescent herbs or subshrubs. Stems ascending, to 6 dm tall, brown, striate, sparsely spreading pubescent, densely pubescent in grooves. Leaves ovate, blades to 4 cm long, to 1.5 cm broad, appressed strigose, glabrate; apices short acuminate to acute, margins dentate, base rounded to truncate; petioles 1–7 mm long, hispid. Capitate cymes mostly spicate from axils of upper leaves (caducous so often absent at anthesis); subtended by an involucre of lanceolate bracts, strigose and sparsely stipitate glandular. Flowers dimorphic, calyx tube campanulate, lobes short acuminate, about 1.5 mm long, bearded on the adaxial tip; petals purple, blue, yellow or white, obovate, short clawed; gynoecium densely hairy, almost setose apically; styles united below. Capsules schizocarpic, spheroid, 3–3.2 mm long, stipes 1–1.5 mm long, lower portion spreading pubescent. Seeds 1 per locule, 2–2.5 mm long, mottled; placentation axile. Year round. Pinelands, flatwoods, roadsides, and waste places. CP: primarily s FL. (Glynn County, GA). *Riedlea hirsuta* Cav.—S. Widely distributed in the tropics and subtropics of the New World. Ours are var. *villosa*.

2. *M. CORCHORIFOLIA* L., Chocolate-weed—Annual herbs, stems single, erect or multiple-stemmed and ascending to divaricate, hollow on older growth, to 9 dm tall, with decurrent lines of stellate pubescence (especially evident above), otherwise sparsely stellate. Leaf blades green to almost completely red, (cordiform) ovate to lance-ovate, often with a shallow cleft near the terminus of primary lateral veins on larger leaves, to 10 cm long,





4 cm broad, depressed reticulate above, venation obscurely palmate, sparsely hirsute along primary veins above and below, apices acute to short acuminate, margins serrate, bases cordate to truncate; petioles much shorter or exceeding the blade length, densely stellate and somewhat flattened along the adaxial surface; stipules subulate, to 4 mm long, bristle tipped. Inflorescences compact cymes terminal on primary or lateral stems, infrequently appearing racemose due to loss of leaves; bracts subulate with bristly margins forming a loose involucre; pedicels stout, ca 1 mm long. Flowers monomorphic; calyx of basally united sepals, lobes ovate, to 2.5 mm long, moderately strigose abaxially; petals pink, white, yellow or purple apically, yellow basally, spatulate, short clawed, stamen tube basally adnate to the petals; gynoecium ovate in outline, ca 1.5 mm long, densely strigose, styles short, stigmas free. Capsules initially loculicidal, becoming schizocarpic, broadly ovoid, shallowly depressed along the sutures, carpels ridged apically, ca 5 mm broad, moderately hirsute. Seeds somewhat trigonous with adaxial faces flattened to slightly concave, abaxial surface rounded, to 2.5 mm long; placentation basal. Late summer to fall, year round in peninsular FL. Fields, lawns, roadsides, waste places, infrequently aquatic; CP: AL, AR, FL, GA, LA, MS, NC, and SC [TX]. A pantropical and pansubtropical weed introduced in the New World. Extremely variable morphologically with numerous varieties named. Resembles *Malvastrum*, yet distinguished by the calyx length of 2.5 mm whereas *Malvastrum*'s calyx length is ca 5 mm long.

3. *M. TOMENTOSA* L., Woolly Pyramid Bush—Shrubs with stems to 2 m, densely covered with greenish, stellate pubescence on young twigs, older stems glabrate, brownish. Leaves deciduous, densely stellate pubescent; blades ovate, 1–5 cm long, 1–4 cm broad, apices acute, margins crenate to dentate, bases cordate to truncate; petioles 4–15 mm long. Cymes axillary or terminal on peduncles ca 1 cm long; bracts subulate. Flowers dimorphic; calyx tube

campanulate, lobes lanceolate, to 3.5 mm long, densely stellate pubescent; petals rose purple to blue, to 13.5 mm long; stamens exerted, filaments basally adnate to the petals; gynoecium pyriform, 4–14 mm long, styles connate below, free apically, stigmas papillose; pedicels 2–3 mm long. Capsules schizocarpic, pyramidal with winglike lobes, to 12 mm broad, densely pubescent. Seeds mottled, dark brown, 1.5–1.7 mm long, somewhat dolabri-form. Year round. Rocky pinelands, xeric tropical hammocks; CP: s FL [s TX]. *Moluchia tomentosa* (L.) Britton—S. Rare in the flora area, known only from Dade and St. Lucie counties, FL. Widely distributed in the New World tropics and subtropics. Ours are var. *tomentosa*.

4. *M. PYRAMIDATA* L., Pyramid Bush—Slender annual or perennial herbs or subshrubs; stems to 2 m, erect or sprawling, pubescent along flattened side in new growth, glabrate. Leaf blades ovate to lanceolate, to 4 cm long, essentially glabrous above, scattered trichomes restricted to primary veins below, apices acute to short acuminate, margins dentate, bases rounded to remotely cordate; petioles to 1 cm long, pubescent adaxially; stipules subulate. Flowers solitary or in cymose, leaf-opposed inflorescences; peduncles 5–15 mm long, adaxially pubescent; bracteoles subulate; pedicels ca 1.5 mm long. Flowers dimorphic; calyx tubes campanulate, lobes 3 mm long, acuminate, margins and veins ciliate; petals lavender-blue, 6–7 mm long; staminal tube adnate to the petals, filaments free above the adnation; gynoecium ellipsoid in outline, 3.7–9 mm long, styles united for ca half their length. Capsules septicidal, sometimes apparently schizocarpic, pyramidal with winglike lobes, to 1.5 cm broad, ciliate along the veins, sparsely pubescent elsewhere. Seeds brownish, striate, to 1.7 mm long. Late summer to fall; year round in southern range. Roadsides, spoil banks, levees, disturbed areas; CP: FL and LA [TX]. Known from a few widely scattered localities in the flora area, i.e. Dade and Monroe counties, FL, and East Baton Rouge Parish, LA.

ACKNOWLEDGEMENTS

The author is grateful to the curators of the above-mentioned herbaria for the loan of materials under their purview. Mr. Bill Burke of the J. N. Couch Library of the University of North Carolina and Dr. David E. Boufford of the Arnold Arboretum of Harvard University provided bibliographic assistance which greatly facilitated the study. B. T. Whetstone and C. M. De Fiori aided in the processing of herbarium materials and the manuscript. For those persons, I am indeed appreciative. As always, errors contained herein remain the sole responsibility of the author.

REFERENCES

- BRIZICKY, G. K. 1966. The genera of Sterculiaceae in the southeastern United States. *J. Arnold Arbor.* 47: 60–74.
 CHAPMAN, A. W. 1884. *Flora of the southern United States* . . . Ivison, Blakeman,

Taylor, and Company, New York.

CRISTOBAL, C. L. 1960. Revision del genero *Ayenia* (Sterculiaceae). Opera Lilloana 4: 1-230.

GOLDBERG, A. 1967. The genus *Melochia* (Sterculiaceae). Contr. U. S. Natl. Herb. 34: 191-363.

KOSTERMANS, A. J. G. H. 1957. The genus *Firmiana* (Sterculiaceae). Reinwardtia 4: 281-310.

RADFORD, A. E., C. R. BELL, J. W. HARDIN, and R. L. WILBUR. 1967. Contributors' guide for the "Vascular flora of the southeastern United States." Department of Botany, University of North Carolina, Chapel Hill.

SMALL, J. K. 1933. Manual of the southeastern flora. Published by the author, New York.

WILLIS, J. C. 1973. A dictionary of the flowering plants and ferns. Eighth edition, revised by H. K. Airy Shaw. Cambridge at the University Press, London.

APPLICATION OF THE NAMES *VERBESINA MOLLIS* AND *VERBESINA SERICEA* (COMPOSITAE: HELIANTHEAE)

NEIL A. HARRIMAN

*Biology Department, University of Wisconsin-Oshkosh
Oshkosh, WI 54901*

Two very distinct species of Mexican *Verbesina*, *V. mollis* and *V. sericea*, have long been confused. The error stems from Klatt (1884), who reduced *V. sericea* to the synonymy of *V. mollis*, justified solely by "15. Von *Verbesina mollis* HBK. fehlt ein Original-Exemplar, aber *V. sericea* Knth. & Bouché ist nach meiner Ansicht identisch mit *V. mollis*." Not only are the species amply distinguished in the type descriptions (both authored by Kunth), but also Klatt studied only specimens from B, and did not study the holotype of *V. mollis* at P.

Klatt's reduction was accepted by Robinson and Greenman (1899) in their synopsis of *Verbesina*. They assigned their "*V. mollis*" to sect. *Saubinetia*, characterized by short, little-exserted rays; my examination of specimens annotated by them indicates, as might be expected, that they had only *V. sericea* at hand when they did their work. Proper *V. mollis*, with its long-exserted rays, would come to sect. *Verbesinaria* in their work.

Blake (1926) followed Robinson and Greenman in including a "*V. mollis*" in his treatment of the woody composites of Mexico. He gave the range as "Oaxaca; type collected between Guanajuato and Villalpando". The first element in this range represents the distribution of *V. sericea*, while the second element represents the type locality of *V. mollis* as given in Humboldt et al. (1818; 1820), in the state of Guanajuato, not Oaxaca, and some 500–600 km north of Oaxaca.

Because *V. sericea* is so clearly woody, workers have routinely identified it in Blake's key, and herbaria contain many specimens of *V. sericea* labelled as *V. mollis*. Specimens of the obviously herbaceous, long-rayed *V. mollis* are often filed with it. The two species may be separated by the following key.

- Herbaceous perennials, 4–15 dm tall; leaves harshly pubescent and green above, softly white-tomentose below, decurrent, the stems prominently winged; rays bright yellow, 7–10 mm long, equalling or exceeding the disc; northeastern and central Mexico, north of Oaxaca 1. *V. mollis*.
Shrubs, to 1.5 m tall; leaves softly pubescent and green above, densely and softly silky-sericeous below, constricted at base, not decurrent, stems winged; rays dull greenish-yellow, 2–3 mm long, scarcely exceeding the involucre and never exceeding the disc; known only from Oaxaca..... 2. *V. sericea*.

1. VERBESINA MOLLIS Kunth, in Humboldt, Bonpland, & Kunth, Nov. Gen. Sp. Pl. (folio edition) 4: 159. 1818; verbatim in the quarto edition 4: 203. 1820.

Herbaceous perennial from a caudex. Stems erect, 4–15 dm tall. Leaves alternate, basal and mid-cauline broadly ovate to lanceolate, toothed, 2–2.5 cm wide, 6–12 cm long, all but the uppermost bracteal ones narrowed and decurrent at base onto the stem as wings 3–5 mm wide (the wings very rarely lacking), lacking or nearly so on the upper third of the stem; stiffly hirsutulous above, softly pilose to tomentose beneath, atomiferous-glandular below beneath the pubescence, leaves and the stem wings strongly bicolorous. Heads 3–15 (20) in a very open panicle, peduncles 1–17 cm long, naked or very sparsely and distantly bracteate. Involucre campanulate, 5–7 mm high, phyllaries ca 30, narrowly lanceolate to linear, hirsute, barely imbricated in about 3 series, somewhat spreading or reflexed at maturity. Rays ca 13, fertile, yellow, 7–10 mm long, equalling or exceeding the disc. Ray achenes brown-black, sometimes tan-tuberculate on both faces, the body 4 mm long and 2 mm wide, 1-nerved on each face, oblanceolate, very broadly winged from base to summit, the wing on each side ca 1.25 mm wide, tan to white; pappus awns 2, without intermediate squamellae, stiff, persistent, 2.25 mm long, tan to white, antrorsely hispidulous. Pales concave and slightly keeled, oblanceolate, shorter than the disc florets, hyaline below, narrowed to an elongate-deltoid herbaceous, hispid, acute tip, persistent after the shedding of the achenes. Disc florets 80–90, corollas yellow, tube 0.75 mm long, throat expanded, 2.5 mm long, the deltoid lobes 0.4–0.5 mm long, thinly hairy throughout. Disc achenes like those of the rays. Chromosome number unknown.

Distribution. Oak and pine woodlands, ravines, and roadsides, northeastern and central México, from Coahuila and Nuevo León south to Jalisco and Querétaro; flowering and fruiting Aug–Nov.

TYPE: MEXICO. GUANAJUATO: "inter Guanajuato et Villalpando", *Humboldt and Bonpland s.n.* (HOLOTYPE: P; photograph of holotype: GH!. MICH!, OSH!; IDC microfiche #6209. 107:II.6!). Fig. 1.

Representative specimens: MÉXICO. COAHUILA: *Robert 172* (MICH)—an extreme variant with unwinged stems and leaves nearly concolorous; GUANAJUATO, *Moore and Wood 4767* (GH, MICH, WIS); JALISCO, *McVaugh 24315* (MICH); NUEVO LEÓN, *Brunken and Perino 209* (OS, OSH); QUERÉTARO, *Crawford et al. 1355* (OS, OSH); SAN LUIS POTOSÍ, *Rzedowski 11333* (CAS, OS); ZACATECAS, *Rzedowski y McVaugh 951* (MICH).

2. VERBESINA SERICEA Kunth & Bouché, Sp. Nov. Hort. Berol. 14, in Ind. Sem. Hort. Berol. 1848. 1849; verbatim republication, Ann. Sci. Nat. Bot. series III. 11: 228. 1849.

Vernonia exaltata Hort. ex Kunth & Bouché, locis citatis, nom. nud.

Vernonia karwinskiana Hort. ex Kunth & Bouché, locis citatis, nom. nud.; not *Vernonia karvinskiana* DC., Prod. 5: 62. 1836.



Figure 1. *Verbena mollis* (Rzedowski y McVaugh 951, MICH).

From the context of the two publications of Kunth and Bouché, I infer that these nomina nuda were labels for plants in the garden; no formal descriptions accompanying these names were ever published. No specimens under these names are extant in B.

Shrub or sub-shrub to 1.5 m tall. Leaves alternate, ovate-lanceolate, 5.5–10 cm long, 1.7–3.5 cm wide, narrowed proximally to a short subpetiolar base, not decurrent onto the stem, bicolored, green and thinly pilose above, densely silvery-sericeous below, not atomiferous glandular beneath the pubescence, indistinctly callus-toothed or entire. Stem wings 1–3.5 mm wide, bicolored, lacking with age. Heads 1–20, terminating elongated axillary peduncles and more commonly in congested cymes at the ends of branches, at first hemispheric, later globose. Involucre campanulate, 3–3.5 mm high, phyllaries ca 21 in 3 indistinct series, scarcely imbricated, the 4–5 outermost ones obovate, blunt, sericeous, the inner lanceolate, acute, sericeous, spreading or reflexed at maturity. Rays 7–9 (13), fertile, dull yellow-green, 2–3 mm long, not or barely exceeding the involucre, tube pilose. Ray achenes black, flattened parallel to the phyllaries but tending to be quadrangular by enlargement of the facial areas, appressed sericeous, 1.5–1.75 mm long, the white wings ca 0.25 mm wide; pappus awns 2, without intermediate squamellae, fragile, microscopically antrorsely barbed, barely 0.5 mm long. Pales slightly keeled, oblanceolate, shorter than the disc florets, hyaline below, green to brown above, the tip triangular, externally pilose, persistent after the shedding of the achenes. Disc florets ca 100, corollas dull greenish-yellow, tube 1 mm long, pilose, limb 1.75 mm long, lobed about halfway, pilose at base, lobes nearly glabrous. Disc achenes black, 1.75–2 mm long, strongly flattened, thinly sericeous or glabrous on the faces, wings white, each about 0.5 mm wide, pappus awns 2, very fragile. Chromosome number unknown.

Distribution. Rather arid, brushy savannas and cutover forrests; known only from Oaxaca where it is apparently not rare; flowering and fruiting Aug–Nov.

TYPE: neotype (here designated) MÉXICO. OAXACA: Monte Alban, near Oaxaca, 5,800 ft, 3 Sep 1894, *Pringle* 4863 (NEOTYPE: US 1418089!; ISONEOTYPES: GH!, UC!, MICH!).

The original material was cultivated in the Berlin Royal Botanical Gardens from seed sent by Karwinski from México; a specimen was not preserved in B, nor in P, or if preserved in B then destroyed in World War II, fide Oberkustos Dr. H. W. Lack, pers. comm., 5 May 1981; possible type material is an excellent tracing and some leaf fragments, GH! ex herb. Klatt, but there is no clue to the provenance or age of the specimen. Fig. 2.

Representative specimens: MÉXICO. OAXACA: *Cronquist* 9688 (MICH, US); *La Duke et al.* 503 (OS, OSH); *Hartman and Funk* 4164 (OS, TEX); *Breedlove* 35951 (CAS).



Figure 2. *Verbesina sericea*, isoneotype (Pringle 4863, GH).

ACKNOWLEDGMENTS

I thank the curators at CAS, GH, MICH, OS, TEX, WIS, UC, and US for the loan of specimens, and the curators at B and P who kindly searched for type material and sent photographs. And I especially thank Tod F. Stuessy (OS) for the facilities and encouragement he provided while I was on a sabbatical at his institution.

REFERENCES

- BLAKE, S. F. 1926. Compositae. *In*. Trees and shrubs of Mexico. P. C. Standley. Contr. U.S. Natl. Herb. 23: 1313–1721.
- HUMBOLDT, A., A. BONPLAND, et C. S. KUNTH. 1818. Nova Genera et Species Plantarum (folio edition) 4: 159. 1820 (quarto edition) 4: 203.
- KLATT, F. W. 1884. Beitrage zur Kenntniss der Compositen, Beschreibung neuer Arten und Bemerkungen zu alten. Leopoldina 20: 74–76; 89–96.
- ROBINSON, B. L. and J. M. GREENMAN. 1899. Synopsis of the genus *Verbesina* with an analytical key to the species. Proc. Amer. Acad. Arts 34: 534–566.

THE EVOLUTIONARY ORIGIN OF *BLUMEA VISCOSA* (ASTERACEAE) AND A FIRST REPORT FROM NORTH AMERICA

GUY L. NESOM

Department of Biology, Memphis State University, Memphis, TN 38152

Blumea viscosa (Mill.) Badillo has had an erratic recent nomenclatural history (Badillo, 1974; D'Arcy, 1972, 1975), but its evolutionary affinities are now better understood and its generic placement and epithet appear to be stabilized. To the list of synonyms of this species must be added *Conyza chiapensis* Brandg. (Univ. Calif. Bot. 10: 419. 1924. TYPE: MEXICO. CHIAPAS: sandy arroyo near Jalisco, *Purpus* 8987—HOLOTYPE: ~~US~~^{UC}; ISOTYPE: MO!).

Blumea viscosa occurs in South America from Bolivia to Columbia and Venezuela (Badillo, 1974). It is also known from the following collections (MO): CENTRAL AMERICA: Panama, Costa Rica, Honduras, and Guatemala; MEXICO: Yucatan, Chiapas, Oaxaca, Morelos, Guerrero, Michoacan, and Veracruz (the last the type locality of the species); WEST INDIES: Barbados (Gooding et al, 1965), Cuba, and Isla de Pinos. It previously has been unreported from North America (Kartesz and Kartesz, 1980), but the species has at least once grown and been collected there: Florida, no other locality data, 1842-1849, *F. Rugel* 301 (specimen at MO! "ex herb. Mus. Britt.", identified as *Conyza lyrata* HBK.). Almost all collections of *B. viscosa* have been from disturbed areas, and it probably would be no surprise to encounter it as a weed at localities along the United States coast of the Gulf of Mexico. Over its whole range, most of the collection localities appear to be coastal or near-coastal, but it has also been recorded from far inland. The species occurs on both the Atlantic and Pacific shores and is known from both by several collections made in the early 1800's.

Randeria (1960) believed that there were "no representatives of *Blumea* in Europe or in the Americas." She was aware of the combination, *B. lyrata* (HBK.) Badillo, but listed it with "taxa and names of uncertain status", apparently assuming that its generic placement was incorrect. After learning that the species indeed is a *Blumea*, as Badillo much earlier had indicated, D'Arcy (1975) noted correctly that it is a member of sect. *Paniculatae* DC. Further, I have studied *B. viscosa* and find that it differs only in a few micromorphological characters from *B. lacera* (Burm. f.) DC. It is much more closely similar to *B. lacera* than is *B. mollis* (D. Don) Merrill, which Randeria considered to be the closest relative of *B. lacera*. Specifically, *B. viscosa* differs from *B. lacera* by its 1) dark, purplish-brown achenes, 2)

Zwillingshaare of duplex trichomes that are widely divergent at their tips, and 3) pappus bristles with relatively long, antrorsely oriented barbels. *Blumea lacera* has orangish-brown achenes, Zwillingshaare with barely divergent duplex trichomes, and pappus bristles that are nearly smooth or have very short barbels barely distinct from the body of the bristle. The pappus bristles of *B. viscosa* are different from any of those illustrated by Randeria as representative of variability within the genus; the bristles of *B. virens* DC. (sect. *Paniculatae*) have distinct, ascending barbels, but they are not nearly as numerous or as long as in *B. viscosa*. Neither have I been able to observe achenes of any species that are as distinctively dark-colored as those of the single American species. I believe *B. viscosa* could justifiably be treated as a subspecies of *B. lacera*, but because of the differences in morphology and their wide disjunction, little would be gained by making yet another combination, if the close relationship between these taxa is recognized.

In Randeria's key to the species of sect. *Paniculatae*, *Blumea lacera* and *B. mollis* are separated from other taxa with glabrous receptacles by having "achenes terete or subangulate" vs. "achenes distinctly ribbed." However, all of these taxa have terete, ribbed achenes; the ribs of *B. lacera* and *B. mollis*, as well as those of *B. viscosa*, are simply thinner and slightly less conspicuous than in the others.

According to Randeria, "*Blumea lacera* is the most widespread and definitely the most variable species of the genus. A great deal of diversity is exhibited by its vegetative organs in the lobing of the leaves, the relative amount of pubescence, and the degree of compactness and laxity of the panicles." *Blumea viscosa* appears to be somewhat less variable in leaf and inflorescence morphology, but the degree of leaf and stem pubescence and glandularity is highly variable. This variability extends to the type specimens of *Conyza viscosa* Mill. and *C. lyrata* HBK. (both synonyms, McVaugh, 1972), probably the two oldest collections of the species. As in *B. lacera*, however, there are no morphological discontinuities and no clear geographical distinctions that would require recognition of subspecific taxa.

Reasonably convincing evidence exists to support a hypothesis that the Asian-American disjunction between the sister taxa *Blumea lacera* and *B. viscosa* has resulted from an event of long-distance dispersal rather than a more ancient splitting of ancestral stock to produce vicarious taxa. *Blumea viscosa* probably is directly derived from *B. lacera*. The latter has an extremely wide geographic range ("Africa, SE Asia, from India to the Ryukyus and New Guinea to Northern Australia and Guam", Randeria, 1960) and appears to be ecologically equivalent to *B. viscosa*; both are successful colonizers of disturbed sites. The primarily coastal habitats of *B. viscosa* might be expected if the initial American propagules were pre-adapted to such sites, where it is likely they would have had a first opportunity to germinate. All species of the genus have an efficient mechanism for wind dispersal (the pappus),

and according to Randeria, the genus is "extending its geographic range; this is proved by the records in recent years of *Blumea* from places from which it had been unreported previously." For example, the presence of *B. laciniata* (Roxb.) DC. on the Hawaiian Islands is probably due to a recent introduction (Randeria, 1960); otherwise it occurs in India, New Guinea, and the Solomon Islands.

It is impossible to date the dispersal event that could have introduced the stock of *Blumea viscosa* to the American continents, but that it is of some antiquity is suggested by several observations. The morphological divergence between *B. lacera* and *B. viscosa* is slight, but it is consistent and involves at least three characters. Of course, since one of these is a modification of the pappus bristles that conceivably could enhance dispersal capability, the founder achenes themselves could have possessed bristles with such an atypical, variant feature. Also, *B. viscosa* is widespread in Central and South America. This does not eliminate the possibility of a recent introduction, but at least the widely separated type collections of *Conyza viscosa* (Veracruz, Mexico) and *C. lyrata* (Guayaquil, Ecuador) were made prior to 1800 and both possess the features unique to the species.

ACKNOWLEDGEMENTS

I am grateful to the staff of the herbarium and library of the Missouri Botanical Garden for their unabating hospitality and assistance while I was using the facilities there.

REFERENCES

- BADILLO, V. M. 1974. *Blumea viscosa* y *Piptocarpa cuatrecasiana*, dos nuevas combinaciones en Compositae. Rev. Fac. Agron. (Maracay) 8: 9-16.
- D'ARCY, W. G. 1972. A name change in *Pseudoconyza* (Compositae-Inuleae). Phytologia 25: 281.
- 1975. New names and species of neotropical plants: Compositae. Phytologia 30: 5-6.
- GOODING, E. G. B., A. R. LOVELESS, and G. R. PROCTOR. 1965. Flora of Barbados. Her Majesty's Stationery Office, London.
- KARTESZ, J. T. and R. KARTESZ. 1980. A synonymized checklist of the vascular flora of the United States, Canada, and Greenland. The biota of North America, Vol. II. Univ. of North Carolina Press, Chapel Hill.
- MC VAUGH, R. 1972. Nomenclatural and taxonomic notes on Mexican Compositae. Rhodora 74: 495-516.
- RANDERIA, A. J. 1960. The Composite genus *Blumea*, a taxonomic revision. Blumea 10: 176-317.

THE TAXONOMIC STATUS OF *STIPULICIDA FILIFORMIS* (CARYOPHYLLACEAE)¹

WALTER S. JUDD

*Department of Botany, University of Florida,
Gainesville, FL 32611*

Stipulicida filiformis was described by Nash (1895) from plants collected near Eustis, Lake Co., Florida. He noted that the species differed from *S. setacea* (described by Michaux, 1803) in its much more slender stems, inflorescences composed of fewer flowers, i.e., one or two vs. three or more, and shorter bracts. An additional character, petal shape, was used by Small (1933) to distinguish these taxa. *Stipulicida filiformis* is frequent in open, well-drained, sandy areas of "high pineland" (forests of *Pinus palustris*) or "scrub" (forests dominated by *Pinus clausa* and various xerophytic oaks such as *Quercus myrtifolia*, *Q. geminata*, and *Q. chapmanii*); (Nash, 1895, and personal observations).

However, other botanists have not recognized these taxa as distinct (Thorne, 1954; R. Wunderlin, personal communication), and in the course of field work in central Florida the differences between the two taxa appeared to be poorly marked. Thus the variability of *Stipulicida filiformis* and *S. setacea* has been investigated, with special consideration given to the pattern of variation within peninsular Florida, the region of maximum morphological diversity within *Stipulicida*.

Populations of *Stipulicida* were observed and collected in the field. In addition, stem diameter and number of flowers/inflorescence were recorded from herbarium material. Specimens were selected from throughout the range of both species, but with emphasis on peninsular Florida.

The variation in average stem diameter (measured just below the inflorescence of five stems/specimen) was found to be continuous between ca. 0.15 and 0.55 mm, while the average number of flowers per inflorescence (three inflorescences counted/specimen) varied continuously from only one to over eight (Figure 1). It can be seen that plants with only few flowers per inflorescence tend to have more slender and filiform stems than plants with several flowers per inflorescence. Thus plants agreeing with the original description of *Stipulicida filiformis* completely intergrade with *S. setacea* in these characters. Intermediate populations were also seen in the field, e.g.,

¹ This paper is Florida Agricultural Experiment Station Journal Series No. 4288.

Judd 2448 (FLAS) and *Judd 2655* (FLAS). Petal shape and bract size also fail to separate the two supposed species.

It is of interest that filiformis-like plants appear to be limited to the Central Florida Ridge (from Marion Co. south to Highlands Co.; see *Brass 14533* (FLAS, FSU), *D. S. & H. B. Correll 52722* (USF), *Garrett s.n.*, 18 May 1948 (FLAS), *Hansen & Richardson 5766* (USF), *Judd 3148, 3156, 3211* (FLAS), *Ray et al. 10361* (USF)) although more robust individuals are also frequent within this region (Figure 2). Such filiform plants may have an adaptive advantage in the extremely xerophytic sands of the Central Florida Ridge. This region supports many endemic taxa, and distinctive ecotypes of widespread eastern species, e.g., *Bonamia grandiflora*, *Bumelia*

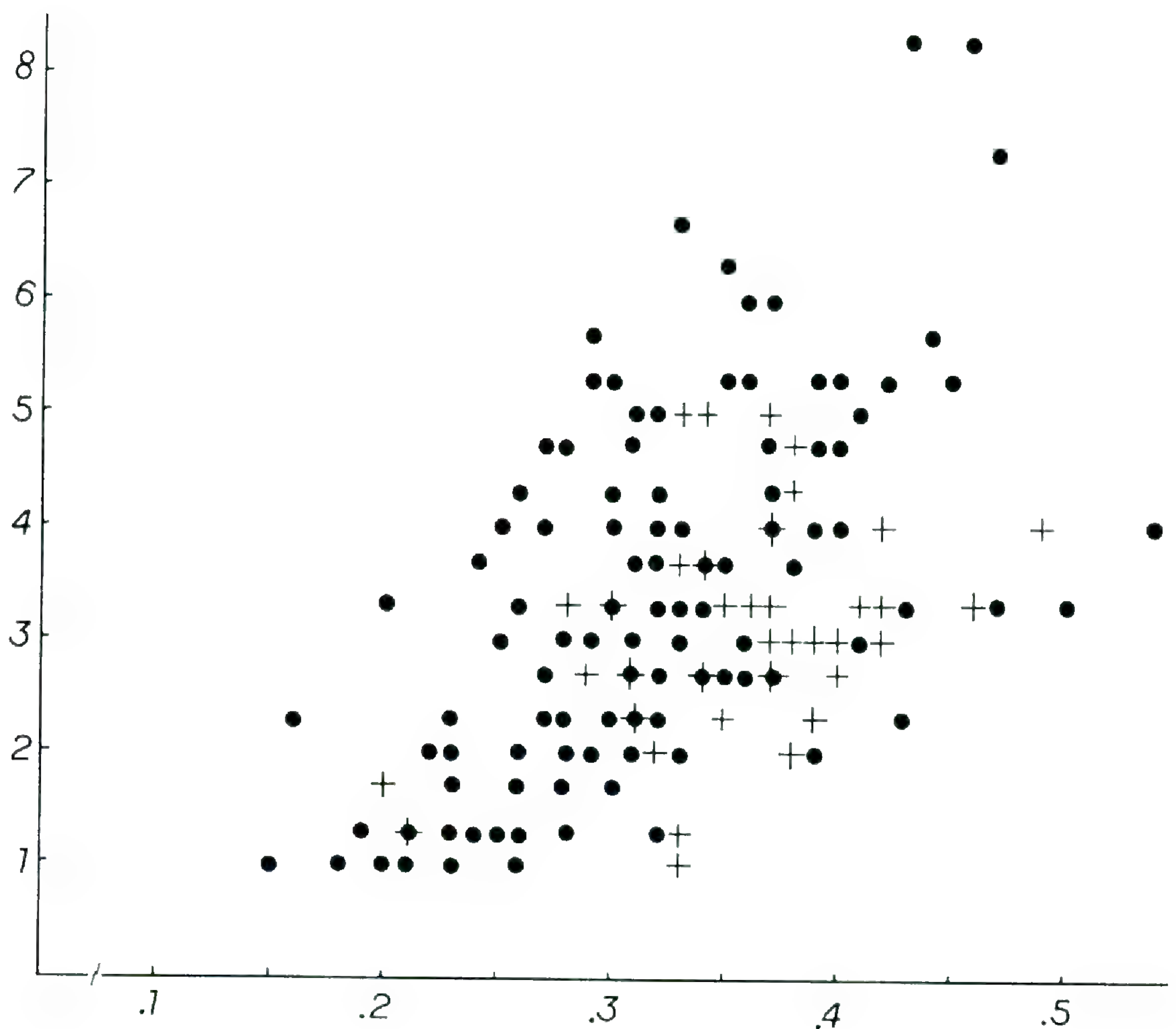


Figure 1. Scatter diagram showing variation in 3 characters within *Stipulicida setacea*. Vertical axis = average number of flowers per inflorescence; horizontal axis = average diameter of stem (measured below inflorescences); dots = plants with entire-margined sepals; crosses = plants with lacerate-margined sepals. Data based upon specimens at FLAS, FSU, and USF.

lacuum, *Chionanthus pygmaeus*, *Dicerandra frutescens*, *Eriogonum floridanum*, *Eryngium cunifolium*, *Garberia fruticosa*, *Hypericum cumulicola*, *Osmanthus megacarpus*, *Persea humilis*, *Polygala lewtonii*, *Prunus geniculata*, *Quercus inopina*, *Sabal etonia*, and *Warea amplexifolia* (see also Ward, 1979).

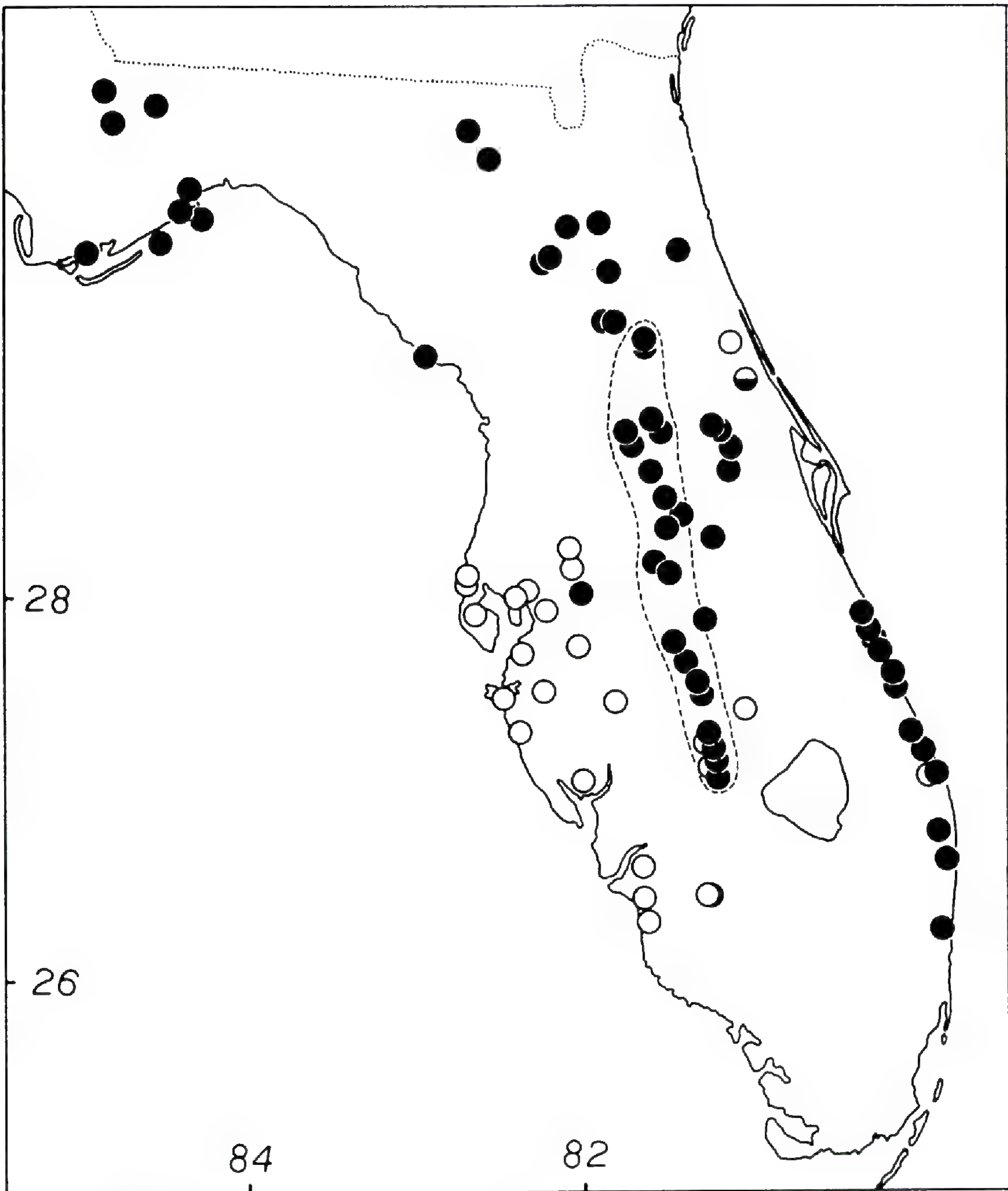


Figure 2. Distribution of *Stipulicida setacea* var. *setacea* (dots), *S. setacea* var. *lacerata* (circles) and intermediate plants (half-shaded circle) within peninsular Florida. Filiformis-like plants essentially restricted to area delimited by dashed line.

It is concluded that *Stipulicida filiformis* merely represents a morphological/ecological extreme of the fairly widespread and variable *S. setacea*, and thus is best treated as a synonym of the latter.

In the course of the above investigation, an interesting, and geographically significant pattern of variation in the sepals was observed. Plants from the Tampa Bay area and southward to northern Collier Co. on the gulf coast have distinctly lacerate sepals, while plants from other regions characteristically have more or less entire-margined sepals (see Figure 2). Such plants have been described as *Stipulicida setacea* var. *lacerata* by James (1957). Intermediate plants are known from Highlands Co. (see James, 1957; *Godfrey* 70824 (FSU)) and Volusia Co. (see *Godfrey* 78756 (FSU) and *D. S. & H. B. Correll* 51934 (USF)). The treatment of these lacerate-sepaled plants as a variety of *S. setacea* seems to be justified. Varieties *lacerata* and *setacea* are essentially allopatric (Figure 2) but occur together in southern Highlands Co. (where intermediates are known), St. John's Co., and Martin Co. Variety *lacerata* has also been reported on the white sand savannas of the Isle of Pines, Cuba (James, 1957). It is noteworthy that the Tampa Bay and southern gulf coast region of Florida supports other endemics or unusual local populations such as *Chrysopsis floridana*, *Eragrostis tracyi*, *Schizaea germanii*, and an unusual pubescence form of *Lyonia fruticosa*.

ACKNOWLEDGEMENTS

I wish to thank the curators of the herbaria (FSU, USF) from which specimens were borrowed for this study.

REFERENCES

- JAMES, C. W. 1957. A new variety of *Stipulicida setacea*. *Rhodora* 59: 98.
 MICHAUX, A. 1803. *Flora Boreali-Americana*. Vol. 1. 330 pp. Levrault, Paris.
 NASH, G. V. 1895. Notes on some Florida plants. *Bull. Torrey Bot. Club* 22: 141–161.
 SMALL, J. K. 1933. *Manual of the southeastern flora*. 1554 pp. "Published by the author," New York.
 THORNE, R. F. 1954. The vascular plants of southwestern Georgia. *Amer. Midl. Naturalist*. 52: 257–327.
 WARD, D. B. (ed.) 1979. Vol. 5, Plants, *In*: P. C. H. Pritchard (ed.), *Rare and endangered biota of Florida*. 175 pp. Univ. Presses of Florida, Gainesville.

EUPATORIUM MOHRII, A NEW RECORD
FOR THE DOMINICAN REPUBLIC, INCLUDING
E. QUINQUEFLORUM, SYN. NOV.
(ASTERACEAE)

VICTORIA I. SULLIVAN

*Department of Biology, University of Southwestern Louisiana,
Lafayette, LA 70504*

The distribution of *Eupatorium quinqueflorum* Urb. and Ekm. is confined to the Dominican Republic and thus is removed from the Arcto-Tertiary pattern of distribution (Li, 1952) described for the genus *Eupatorium* sens. str. (King and Robinson, 1970). Because of this outlying distribution the species became of interest. As far as known only three collections of *E. quinqueflorum* have been made and these were by Ekman in 1929 and 1930:

DOMINICAN REPUBLIC: SANTO DOMINGO: Llano Costero, Sabana Guabatico, at Laguna los Derramaderos, "generally in the capillary water belt (= the *Rhexia* belt)," *Ekman H 13318* (LECTOTYPE and SYNTYPE: S; ISOTYPE: NY); Llano Costero, Sabana del Guabatico, *Ekman H 11047* (S); DE SAMANA: Cordillera Central, Sabana de la Mar, El Valle, "in savanna," *Ekman H 15650* (S, US).

Searches for *E. quinqueflorum* by the author in April, 1977 in the vicinity of El Valle and further searches by Thomas A. Zanoni (pers. com., 1981, taxonomist at Jardin Botanico Nacional Dr. Rafael M. Moscoso in Santo Domingo, Dominican Republic) at Sabana de Guabatico were unsuccessful. Laguna Derramaderos is a seasonally fluctuating lake underlain with a hardpan of caliche that prohibits filtration of water to lower levels of the soil. Cultivation there, according to Zanoni (pers. com., 1981), began with planting of rice 40 to 50 years ago. In 1965, sugar cane was planted in the surrounding savanna area called "Sabana de Guabatico" and, at about the same time, rice culture in the lake was eliminated. Currently, plowing for sugar cane and planting is to the margin of the lake at the time of plowing. For this reason little native vegetation remains around the lake.

The second site for Ekman's collection of *E. quinqueflorum*, the El Valle and Sabana de la Mar area, is also under cultivation. In the higher sites coffee or cacao are planted below tall trees and lower wet areas are grazed, planted with rice, or abandoned according to Zanoni (pers. com., 1981). The history of land use in this area is not known to the author.

The type specimen and other specimens of *E. quinqueflorum* collected by Ekman were examined and found to be morphologically indistinguishable from the type of *E. mohrii* Greene of the southeastern U.S. (see Table 1

Table 1. Comparison of Ekman's specimens of *E. quinqueflorum* (including the type) and the type specimen of *E. mohrii* Greene.

	E. QUINQUEFLORUM	E. MOHRII
LEAVES (MIDSTEM)	Linear-lanceolate to sublinear, tips acuminate, a few large teeth, nearly lobed, 2–5 cm long, 2–5 mm wide or less	Shape, margins and tips same as <i>quinqueflorum</i> , 2.6–3 cm long, 4–6 mm wide
STEMS	20–55 cm tall	incomplete specimen
CAPITULA LENGTH (INC. PAPPUS)	7 mm	7 mm
PHYLLARIES	In 2 series, inner 4.3 mm long, 0.7–0.8 mm wide, linear with obtuse tips	In 2 series, inner 4.5–5.2 mm long, 0.8 mm wide, linear with obtuse tips
COROLLA LENGTH	3.7 mm	3.8 mm
ANTHER LENGTH	1.6 mm	1.7 mm
STYLE LENGTH	4.5 mm	4.1 mm
PAPPUS LENGTH	4.8–5 mm*	5.4 mm
ACHENE LENGTH	2.5 mm	2.6 mm

* pappus not straight

and Figure 1 for comparison). For this reason the oldest available name is accepted.

All of Ekman's specimens of *E. quinqueflorum*, the *E. mohrii* type and plants of *E. mohrii* examined throughout the southeastern U.S. by Sullivan (1976) lack pollen in anthers of preanthetic flowers. Failure to produce pollen is characteristic of agamospermous polyploids of *Eupatorium*, whereas diploids form pollen and reproduce sexually (Sullivan, 1976). The agamospermous triploid, *E. mohrii* ($3n=30$, Sullivan, 1972), is thought perhaps to be of hybrid origin. Plants of *E. mohrii* resemble most closely those of *E. recurvans*, a diploid sexual species ($n=10$, Sullivan, 1976), which occurs in the southeastern U.S. They and plants of *E. quinqueflorum* examined during this study, share a character uniquely different from the other 18 diploid *Eupatorium* species in North America, that of having short swollen rhizomes.

The manner in which *E. mohrii* was transported to the Dominican Republic and thence was collected and described as new remains a matter of speculation. However, the evidence suggests that *E. mohrii* was only a short-lived waif in the Dominican Republic.

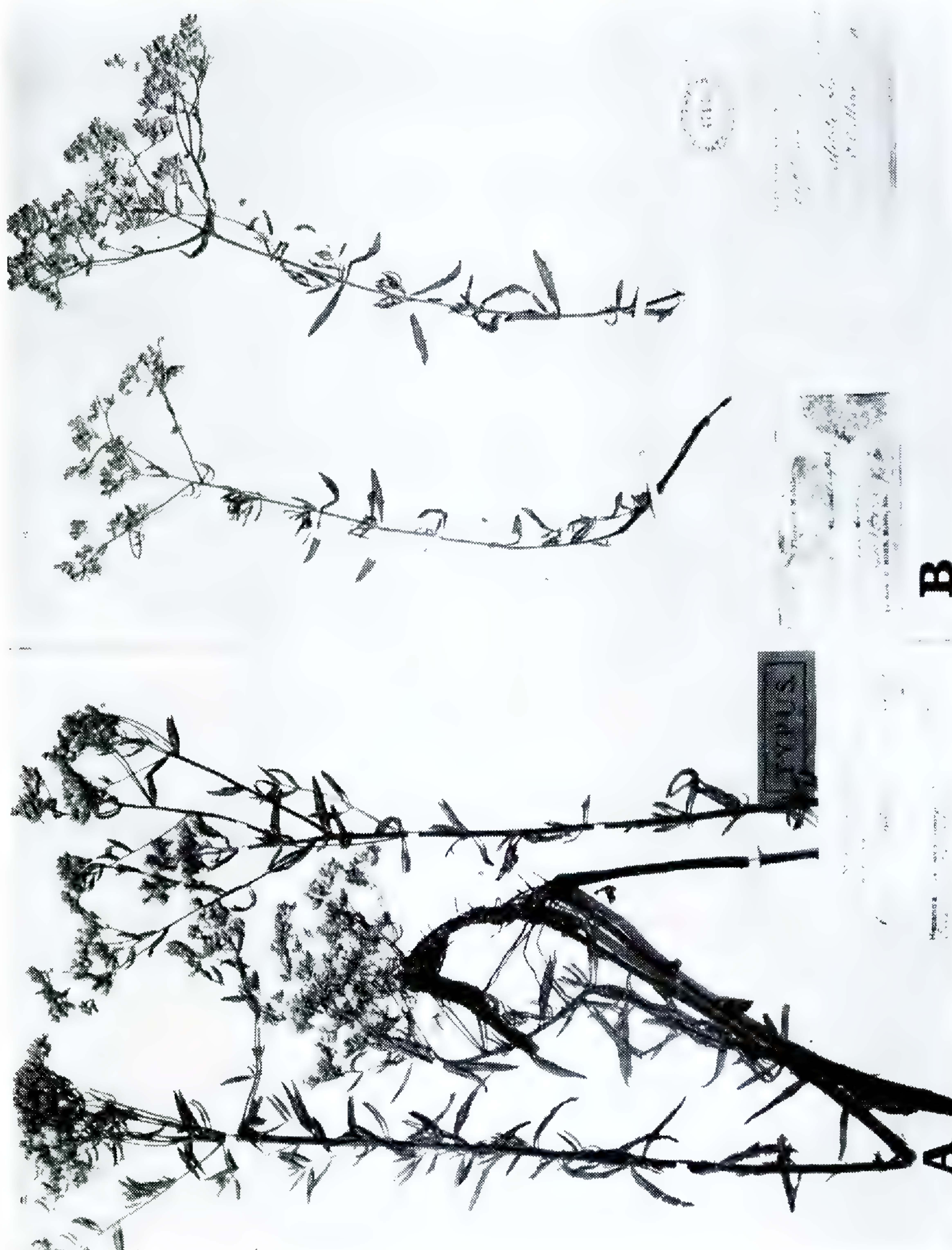


Fig. 1. A. Type specimen of *E. quinqueflorum* Urb. and Ekm. (Ekman H 13318, S). B. Type specimen of *E. mohrii* Greene (C. Mohr s.n. 8 Sep, 1879, Mobile, Ala.).

- EUPATORIUM MOHRII Greene, Contr. U.S. Natl. Herb. 6: 762, tab. 11. 1901.
Uncasia mohrii (Greene) Greene, Leaf. Bot. Observ. Crit. 1: 13. 1903.
Eupatorium quinqueflorum Urb. & Ekm., Ark. Bot. 23A (11): 57. 1931, syn. nov.

ACKNOWLEDGEMENTS

I especially thank Thomas A. Zanoni for searching for *E. quinqueflorum* despite the inaccessibility of the Laguna site and logistical difficulties that ensued. In addition, I thank him for providing much detailed information concerning the Dominican Republic and Ekman's work and for reading and commenting on earlier versions of this paper. I gratefully acknowledge the University of Southwestern Louisiana Foundation for funds for field work in the Dominican Republic and the curators of herbaria who loaned specimens used in this study, US, S and NY. I thank William D. Reese for reviewing the manuscript.

REFERENCES

- KING, R. M. and H. ROBINSON. 1970. *Eupatorium*, a Compositae genus of Arcto-Tertiary distribution. *Taxon* 9: 769–774.
 LI, H. L. 1952. Floristic relationships between eastern Asia and eastern North America. *Trans. Amer. Philos. Soc.* 42: 371–429.
 SULLIVAN, V. I. 1972. Investigation on the breeding systems, formation of auto- and allopolyploids and the reticulate pattern of hybridization in North American *Eupatorium* (Compositae). Dissertation, Florida State University, Tallahassee.
 ———. 1976. Diploidy, polyploidy, and agamospermy among species of *Eupatorium* (Compositae). *Canad. J. Bot.* 54: 2907–2917.

A SYSTEMATIC STUDY OF *ASTER* SECTION *PATENTES* (ASTERACEAE)

RONALD L. JONES

*Dept. of Biological Sciences,
Eastern Kentucky University, Richmond, KY 40475*

ABSTRACT

Aster section *Patentes* is a group of base-5 asters of the eastern United States. The group is characterized by widely-spaced, strongly-clasping cauline leaves, abruptly-reduced peduncular bracts, and glandular, green-tipped phyllaries. Three species are recognized in the section: *Aster phlogifolius* Muhl. ex Willd., a tetraploid, Appalachian taxon; *Aster georgianus* Alexander, a decaploid, Piedmont taxon; and *Aster patens* Ait., a wide-ranging taxon including both diploid and tetraploid populations, and divisible into three geographic varieties—the southwestern var. *gracilis* Hook., the Interior Highland var. *patentissimus* (Lindl.) T. & G., and the eastern var. *patens*. The results of historical, morphological, chromosomal, hybridization, and ecological studies are presented, and the taxa are keyed, described, mapped, and synonymies are given.

INTRODUCTION

The taxa centered around *Aster patens* Ait., were grouped as section *Patentes* of the subgenus *Aster* in Torrey and Gray's *Flora of North America* (1841). This group of taxa, here divided into three species, has been subjected to various treatments, being segregated into six species in some treatments (Burgess in Small, 1903; Alexander in Small, 1933), and grouped into a single species, *Aster patens*, in others (Torrey and Gray, 1841; Gray, 1884; Fernald, 1950; Gleason and Conquist, 1963; and Cronquist, 1980). The synonymy of the group involves 22 names.

This paper represents the first effort at a systematic study of *Aster patens* and related taxa. A part of the study was done to gain an understanding of the affinities of the group to other asters. Therefore, included in this paper, are correlative studies, observations, and comments on other base-5 asters, especially the section *Grandiflori*. Special attention is given to the resemblance and possible relationships between *Aster georgianus* Alexander and *Aster grandiflorus* L.

MATERIALS AND METHODS

This study is based primarily on field familiarity with the plants, gained from visits to over 100 populations in 14 states. Transplants representing all taxa were grown at a garden in northwest Davidson County on a rich creek-bottom site in full sunlight for 2–4 years. Additional transplants were maintained at the Vanderbilt University garden and greenhouse. Seedlings

representing all taxa were raised to maturity in a potting soil mixture in the greenhouse and observed for 1–2 years. Voucher specimens from garden and greenhouse plants are housed at VDB.

A total of 3104 specimens from 32 herbaria were examined during this study. A citation list of these specimens is available upon request. All of these specimens were subjected to a detailed qualitative and quantitative analysis, including surveys of habit (slender rhizomes vs. caudices), leaf length and width, phyllary tip length (green portion), phyllary pubescence and width, and involucre height. These data were then used to prepare a series of maps, histograms, and scatter diagrams (R. Jones, 1980).

Population samples were also gathered (15–20 specimens per population, 5 populations per taxon), and used to prepare additional tables for comparisons of morphological features, including guard cells and pollen grains.

Seedling root tips from germinating achenes were used to obtain chromosome counts. In most instances achenes germinated readily at room temperature on moist filter paper in a petri dish (achenes of *Aster phlogifolius* require a cold treatment for good germination). The Fuelgen techniques, with pretreatment in 0.03% 8-hydroxyquinolin, was used to make the counts. Slides were made permanent by the dry-ice freeze method, and documented by photographs and camera-lucida drawings.

In hybridization studies, the crosses were accomplished by rubbing together the flowering heads of different individuals. Heads were bagged before and after crossing to prevent contamination. About a month later the heads were harvested and percentage seed set determined; each head was considered as a single crossing attempt.

TAXONOMIC HISTORY

The taxonomic history of *Aster* section *Patentes* began in 1789 with the original description of *Aster patens* in William Aiton's *Hortus Kewensis*. Gray (1882) states that Solander was the actual founder of the asters in *Hortus Kewensis*, and Krok (1925) lists *Aster patens* as a name attributable to Dryander. Aiton is cited as the official author of *Aster patens*, however, because neither Dryander or Solander were acknowledged in the work.

According to the type citation, the specimen (BM) that provided the basis for the original description of *Aster patens* was a "native of Virginia, introduced about 1773 by George Ausrere, Esq." This specimen was collected from the Chelsea Physic Garden, and is a part of the Philip Miller herbarium. Miller was evidently not the actual collector of the cultivated specimen, because the introduction date of 1773 was two years after his death.

The specific epithet *patens* referred to the spreading, elongate branches; this species was characterized further in its type description by the roughly-pubescent stems, the oblong, entire, acute, cordate-clasping and scabrous leaves, and the imbricate, slightly recurved phyllaries. Since its original publi-

cation, *Aster patens* has been widely accepted as a distinct species of the eastern United States.

Willdenow (1803) described *Aster phlogifolius* from a specimen (B) collected by Muhlenberg in Pennsylvania. The specific epithet referred to the phlox-like leaves, which were described as lanceolate, entire, cordate-amplexicaul, and softly pubescent. The original description also referred to the pubescent, unbranched, and apically-panicled stems, and the loosely imbricated and lanceolate phyllaries. This Willdenow taxon was reduced to a variety of *Aster patens* by Nees (1832); most subsequent authors, including Cronquist (1980) and A. Jones (1980b), have followed this judgment. In this treatment, however, I have accepted *A. phlogifolius* as a species distinct from *A. patens*.

In the early part of the 19th century many authors confused *Aster patens* and *A. phlogifolius* with *A. undulatus* L., *A. diversifolius* Michx., and *A. amplexicaulis* Michx. (*non* Lam., *nec* Muhl. ex Willd.). This confusion was clarified by Gray (1882, 1884), who stated that *A. amplexicaulis* Michx. was *A. patens* Ait., and that *A. diversifolius* Michx. belonged with *A. undulatus* L. My determinations from type material of the Michaux and Linnaean taxa are in accord with those of Gray.

Aster patens var. *gracilis* was described by Hooker (1835) from specimens (K!) collected by Drummond near Jacksonville, Louisiana, in 1832. This varietal epithet applies to the slender habit of the plants, noteworthy for their long branches and small leaves. It should be noted that the Jacksonville referred to by Hooker was in Louisiana and not in Florida as stated by Mohr (1901). Current maps do not indicate a Jacksonville for Louisiana, but Tanner (1844) shows a Jacksonville in Washington Parish, just east of Franklinton, on the Bogue Luse River, near the present town of Sheridan.

Drummond was also the collector of the type specimen of another currently recognized variety—*Aster patens* var. *patentissimus*. This specimen (CGE!) was collected in the vicinity of St. Louis, Missouri in 1831. Lindley (1836) distinguished *A. patentissimus* from *A. patens* by its very spreading branches, its short-peduncled, turbinate heads, and by its woolly obtuse phyllaries. In the type citation, the distribution is given as "Louisiana," but the type specimen is clearly labeled "Saint Louis." This taxon is here treated in the sense of Torrey and Gray (1841), as a geographic variety of *A. patens*.

As originally conceived by Torrey and Gray (1841), the section *Patentes* consisted of a single species—*Aster patens*, with three varieties—*gracilis*, *phlogifolius*, and *patentissimus*. In this first treatment, the section was defined by the rather large heads, with turbinate to campanulate involucre, the closely imbricated phyllaries with spreading tips, the silky-canescant achenes, the cordate-clasping, entire, pubescent or scabrous cauline leaves, and the much smaller leaves of the branchlets (the glandular pubescence of the phyllaries was not mentioned). Included in the synonymy of the group are *A. auritus* Lindley listed under var. *phlogifolius*, and *A. arnottii* Nees ex

T. & G., listed under var. *patentissimus*. After examining type material from these Lindley and Nees taxa, I concur with Gray's placement of these names.

Other names to be placed into the synonymy of var. *patentissimus* are *Aster continuus* Small (1898), and *A. subsessilis* Burgess in Small (1903). Mohr (1901) renamed *A. patens* var. *gracilis* as *A. patens* (var.) *tenuicaulis*, and Burgess in Small (1903) elevated this taxon to the rank of species as *A. tenuicaulis*.

Alexander described two new species in the section *Patentes* from Small's Manual (1933)—*Aster fontinalis* and *A. georgianus*. *Aster fontinalis* was based on a specimen (NY!) collected by Small near Deep Lake, in southern Florida, in 1925. This species was characterized by the linear-elliptic and auriculate-clasping leaves and by the thinly-linear phyllaries. Long (1970) listed *A. fontinalis* as a synonym for his new variety *A. patens* var. *floridanus*, based on a specimen (GH!) collected by Brass from Collier County, Florida, in 1945. As a result of a study of these types and specimens collected during this investigation (R. Jones 1272), I have excluded these taxa from *Aster* section *Patentes*. Cronquist (1980) allies *A. fontinalis* with *A. dumosus* L.

Aster georgianus was based on a specimen (NY!) collected by Cuthbert near Augusta, Georgia, in 1898. Alexander delimited this Georgia aster from *A. patens* by its fewer branches, thicker leaves, and larger heads. This taxon met with little acceptance until 1977 when Cronquist proposed varietal status under *A. patens*. *Aster georgianus* is maintained in this revision as one of the three distinct species in *Aster* section *Patentes*.

Published names associated with *Aster patens* and not previously discussed include: *A. patens* Ait. f. *rosea* Svenson (1936), a pink-liguled form of *A. patens*; and *A. patens* var. *patens*, validated by Cronquist in 1947 as the typical variety of the species.

Semple and Brouillet (1980a,b) placed *Aster patens* along with other base-5 asters in the genus *Lasallea* Greene; all of these taxa were then transferred for reasons of priority to the genus *Virgulus* Raf. by Reveal and Keener (1981). These nomenclatural changes have resulted in the publication of six new combinations related to *A. patens*, and a total of 40 new combinations related to base-5 asters.

SECTIONAL LIMITS AND RELATIONSHIPS

The evolution and classification of the chromosome groups in *Aster* based on $x = 5, 8$, and 9 are the subjects of recent publications and considerable disagreement. I would agree that the base-5 asters constitute a distinct phylogenetic grouping, but I have classified them as a subgenus, for reasons cited by A. Jones (1980a), rather than as a separate genus, as proposed by Semple & Brouillet (1980a), and followed by Reveal and Keener (1981).

According to the classification of A. Jones (1980a), the subgenus *Virgulus* includes six sections of base-5 asters, one of which is the section *Patentes*.

The section *Patentes* is expanded to include the southeastern *Aster walteri* Alexander in Small, and *A. adnatus* Nutt., the Bahaman *A. lucayanus* Britt., and the Central American taxa centered around *A. moranensis* H.B.K. These taxa, however, possess features that set them apart from *A. patens*, *A. georgianus*, and *A. phlogifolius*. Both *A. walteri* and *A. adnatus* have numerous, tiny, bract-like leaves and hispidulous pubescence. *A. lucayanus* has sessile, oblanceolate leaves and sericeous pubescence, and *A. moranensis* has sessile, linear-oblong leaves and pilose pubescence. I have thus excluded these taxa from the section, and included in my study only those taxa that are clearly allied with *A. patens*.

Other species of the United States that are close relatives of *Aster patens*, but are traditionally placed in different sections, include *A. grandiflorus* L., *A. novae-angliae* L., *A. oblongifolius* Nutt., and *A. carolinianus* Walt. As a group, these taxa differ from the *Patentes* by the more crowded leaves, usually over 30 below the inflorescence, the leaves more linear-elliptic and only sessile to auriculate, and the penduncular bracts only gradually reduced from the upper cauline leaves. Because of its vine-like habit and glabrous achenes, *A. carolinianus* stands out as a distinct section (*Sagittiferi* Gray), but the relationships of the other three species are less clear (see A. Jones, 1980a; Semple & Broillet, 1980a). These three species are here referred to as the section *Grandiflori* T. & G.

CHROMOSOME NUMBERS AND KARYOTYPES

Prior to this study haploid chromosome numbers of 5, 9, 10, and 20 had been published for *Aster patens*, but numbers for *A. phlogifolius* and *A. georgianus* were unknown. For this study mitotic chromosome counts from 45 populations of *Aster* section *Patentes* were determined. For number and karyotype comparisons with the section *Grandiflori*, counts were also made from two populations of *A. grandiflorus*, one of *A. oblongifolius*, and one of *A. novae-angliae*.

The results of the chromosome number studies are listed in Table 1. All of the taxa investigated have chromosome numbers based on $x=5$. These counts confirm the existence of two ploidy levels in *A. patens*, at $2n=10$ and $2n=20$, and provide the first evidence of accessory chromosome in these populations. Original counts are presented for *A. phlogifolius* ($2n=20$), *A. georgianus* ($2n=50$), and *A. grandiflorus* ($2n=60$). These first reports have already appeared in publication (R. Jones and A. Jones, 1979).

ASTER PATENS var. PATENS. Prior tetraploid counts for the species have been reported by Huziwara (1941) from an unknown locality, by Avers (1954) from Indiana, and by Van Faasen and Sterk (1974) from New Jersey. A. Jones (1980b) reported tetraploids from Illinois and Kentucky, and Semple and Brouillet (1980b) have made counts of $2n=20$ from populations in Kentucky, Massachusetts, Mississippi, Missouri, and North Carolina. The listing of the number 20 as a haploid count by Huziwara (1958)

TABLE 1
CHROMOSOME NUMBERS IN ASTER

2n Number	Taxon, Locality, <i>R. Jones</i> Collection Number
ASTER PATENS var. PATENS	
20	ALABAMA. Barbour Co.: Eufaula. 2147.
20	ALABAMA. Etowah Co.: Atalla. 2089.
20	ALABAMA. Lee Co.: Phenix City. 2153.
20	ALABAMA. Marengo Co.: Demopolis. 2142.
20	ALABAMA. St. Clair Co.: Asheville. 2227.
20	ALABAMA. St. Clair Co.: Asheville. 2229.
10	ALABAMA. Sumter Co.: Epes. 2141.
10 + 2B	ALABAMA. Sumter Co.: Gainesville. 2123.
20	ALABAMA. Tuscaloosa Co.: Kellerman. 2121.
20	FLORIDA. Leon Co.: Tallahassee. 810.
20	GEORGIA. Rockdale Co.: Conyers. 2104.
20	KENTUCKY. Carlisle Co.: Wickliffe. 2044.
20	NORTH CAROLINA. Mitchell Co.: Spruce Pine. 1751.
20	TENNESSEE. Cheatham Co.: Ashland City. 1728.
20	TENNESSEE. Dickson Co.: Charlotte. 1230.
20	SOUTH CAROLINA. Charleston Co.: Charleston. 2239.
ASTER PATENS var. PATENTISSIMUS	
20 + 1B	ARKANSAS. Drew Co.: Monticello. 1954.
20 + 0-4B	MISSOURI. Butler Co.: Popular Bluff. 2052.
20	MISSOURI. Butler Co.: Popular Bluff. 2056.
20	MISSOURI. Taney Co.: Forsyth. 2064.
ASTER PATENS var. GRACILIS	
10 + 1B	ALABAMA. Sumter Co.: Livingston. 2130.
10 + 1-2B	ALABAMA. Sumter Co.: Livingston. 2216.
10	ALABAMA. Sumter Co.: York. 2217.
20	LOUISIANA. St. Helena Par.: Greenburg. 2261.
20	LOUISIANA. Tangipahoa Par.: Greenburg. 2265.
20	LOUISIANA. Washington Par.: Bogaloosa. 2266.
10	MISSISSIPPI. Kemper Co.: Scooba. 2218.
10	MISSISSIPPI. Noxubee Co.: Shuqualak. 2215.
10	MISSISSIPPI. Oktibbeha Co.: Starkville. 2213.
10	OKLAHOMA. Osage Co.: Bartlesville. 2069.
10	TEXAS. Anderson Co.: Bushy Creek. 2253.
20	TEXAS. Bowie Co.: Hooks. 2249.
10	TEXAS. Houston Co.: Latexo. 2255.
10	TEXAS. Tyler Co.: Colemeil. 2259.
10	TEXAS. Walker Co.: Huntsville. 2258.
10	TEXAS. Van Zandt Co.: Mineola. 2251.
ASTER PHLOGIFOLIUS	
20	KENTUCKY. Powell Co.: Nada Tunnel. 2038.
20	TENNESSEE. Grainger Co.: Thornhill. 2029.
20	TENNESSEE. Grundy Co.: Palmer. 1987.

ASTER GEORGIANUS

50	ALABAMA. Etowah Co.: Atalla. 2225.
50	ALABAMA. St. Clair Co.: Asheville. 2098.
50	ALABAMA. St. Clair Co.: Asheville. 2226.
50	NORTH CAROLINA. Montgomery Co.: Troy. 2235.
50	NORTH CAROLINA. Union Co.: Monroe. 2233.
50	SOUTH CAROLINA. Cherokee Co.: Blacksburg. 2231.

ASTER GRANDIFLORUS

60 + 0-3B	NORTH CAROLINA. Montgomery Co.: Troy. 2114.
60 + B's	NORTH CAROLINA. Richmond Co.: Ellerbe. 2238.

ASTER NOVAE-ANGLIAE

10	ALABAMA. Greene Co.: Eutaw. 1662.
----	-----------------------------------

ASTER OBLONGIFOLIUS

10	TENNESSEE. Cheatham Co.: Ashland City. 2277.
----	--

was evidently a misprint, because the number was based on his 1941 count of $2n=20$. These counts together with mine suggest that populations of *A. patens* in the eastern United States are exclusively tetraploid, and that diploid plants are encountered only in the southwestern portion of the range of the species.

ASTER PATENS var. PATENTISSIMUS. Accessory chromosomes were noted in tetraploid counts from two populations of this Interior Highland taxon. Anderson et al. (1974) reported an aberrant number of $n=9$.

ASTER PATENS var. GRACILIS. The first diploid count for the species was reported by S. Jones (1968), from a population in Sumter County, Alabama. In recent publications the diploid number has been reported from Baldwin County, Alabama (Semple and Brouillet, 1980b), and from Natchitoches Parish, Louisiana, Lafayette County, Mississippi, and Smith County, Texas (A. Jones, 1980b). The distribution of diploid populations of *A. patens* therefore appears to range from western Alabama to Texas and Oklahoma. Tetraploid plants, however, occur over the entire range of the species. The three populations sampled from the vicinity of the original Drummond collections (R. Jones 2261, 2265, 2266) all yielded the tetraploid count.

ASTER PHLOGIFOLIUS. The tetraploid number of $2n=20$ was confirmed in three populations of this Appalachian taxon. A count of $2n=10_{II}$ was recently published by A. Jones (1980b).

ASTER GEORGIANUS. These decaploid counts from six populations of *A. georgianus* represent the first reports of a chromosome number of 50 among base-5 asters (chromosome numbers of 50 in the base-8 asters are the result of aneuploidy, rather than euploidy). Semple and Brouillet (1980b) also reported a count of $2n=50$ from plants they called *A. patens* in Richland County, South Carolina.

ASTER GRANDIFLORUS. In two populations of this large-headed aster, I found the surprising number of $2n=60 + B's$. A. Jones (1980b) has confirmed this number, publishing a meiotic count of $2n=30_{II}$ from plants that I collected in Montgomery County, North Carolina. This is the first report of a $2n$ number of 60 in the entire genus, and is the highest ploidy level so far determined for a base-5 aster.

ASTER NOVAE-ANGLIAE. The count of $2n=10$ agrees with that reported by many other workers, including Delisle (1937), Huziwara (1941) and Harriman (1978). Avers (1954) reported a tetraploid count.

ASTER OBLONGIFOLIUS. The diploid count was also reported by Stucky and Jackson (1975), but Smith (1965) reported a tetraploid count for plants from Arkansas. Semple and Brouillet (1980b) have obtained the tetraploid count for plants from Missouri, while A. Jones (1980b) reported the diploid count from New Mexico and the tetraploid from Illinois.

KARYOTYPES. As shown in Figure 1, the karyotypes of all the taxa investigated are based on the following haploid chromosome set: two short submetacentrics, about 2.0 and 2.2 μm long; one intermediate-sized acrocentric, about 3.0 μm long; and two longer acrocentrics, about 3.5 and 4.0 μm long. These five kinds of chromosomes are in duplicate in diploid *A. patens*, *A. novae-angliae*, and *A. oblongifolius*, and in quadruplicate in tetraploid *A. patens* and *A. phlogifolius*. The karyotypes of the high-polyploid species are more difficult to analyze, but the better spreads reveal that 20 of the 50 chromosomes of *A. georgianus*, and 24 of the 60 chromosomes of *A. grandiflorus*, are short submetacentrics. These are the numbers expected, assuming that these karyotypes are decaploid and dodecaploid multiples of the base-5 chromosome morphology.

In investigations of other base-5 species (Huziwara, 1958; Semple, 1976) a similar pattern can be identified. These studies also show, however, that there are differences in absolute chromosome size and in the visibility of secondary constrictions. Recently, Semple and Brouillet (1980b) also have noted this basic karyotype similarity among base-5 asters, and have found that the group is further set apart from other asters by differences in satellite chromosome morphology.

These considerations thus support the concept of a fundamental similarity of karyotype among base-5 asters. The simplest explanation of a similarity in chromosome number and morphology is a monophyletic origin of base-5 *Aster*.

MORPHOLOGY

These comments on the morphology of *Aster* section *Patentes* are based on observations and studies of plants in populations, in the garden and greenhouse, and as herbarium specimens. Interpretations of the relative significance of morphological features are based on the constancy of characters in the field and on their persistence in transplants and seedlings.



Figure 1. Chromosome numbers and karyotypes in *Aster* section *Patentes* and section *Grandiflori*. A. *Aster patens* var. *gracilis*— $2n=10 + 1$ B, B. *Aster oblongifolius*— $2n=10$, C. *Aster novae-angliae*— $2n=10$, D. *Aster patens* var. *patens*— $2n=20$, E. *Aster patens* var. *patentissimus*— $2n=20 + 1$ B, F. *Aster phlogifolius*— $2n=20$, G. *Aster georgianus*— $2n=50$, H. *Aster grandiflorus*— $2n=60 + 3$ B, I. Ideogram of base-5 *Aster* karyotype. The B-chromosomes are indicated by arrows.

Those characters that have proven useful in identification of the taxa are presented here within the framework of a discussion of the general morphology of the section.

HABIT. In mixed populations of *A. georgianus* and *A. patens* one of the most obvious differences between the two taxa is the growth habit. *Aster georgianus* is a colonial species—plants produce an extensive system of elongate rhizomes and the aerial stems arise singly, while *A. patens* is a caespitose species—the plants produce caudices and the stems arise in clusters. *Aster patens* will occasionally, especially in the sandy habits of the Coastal Plain, develop short rhizomes from the caudices, but these diploids and tetraploids still do not approach the spreading-colonial habit of the decaploid *A. georgianus*.

A. Jones (1978a,b) has discussed the habit of perennial asters and noted that these features are often genetically fixed and useful in diagnosing taxa. My garden studies suggest that the same observations apply to the *Patentes*—transplants of *A. patens* remain caespitose in the garden, while transplants of *A. georgianus* maintain their colonial habit. Plants of *A. phlogifolius* show no tendencies to be colonial in either the field or the garden; these plants produce a caudex, often with only a single, arching stem, or, in sunny habitats, they may be caespitose.

TRICHOMES. The trichomes of *Aster* section *Patentes* are very similar to those reported by Nesom (1976, 1978) from the related genera *Erigeron* and *Machaeranthera*. The indument formed by the large uniseriate, tapering trichomes on the stems and leaves varies from scabrous in *A. patens* and *A. georgianus* to soft-pubescent in *A. phlogifolius*. Smaller uniseriate trichomes occur on the phyllaries, the density varying with the taxon, being almost absent from the glabrate phyllaries of *A. phlogifolius*, and most prominent on the canescent bracts of *A. patens* var. *patentissimus*.

One of the more common traits of the section *Patentes* is the presence of biseriate, capitate, glandular trichomes, usually less than 0.25 mm long, especially on the phyllaries. Eglandular plants are found typically only in *A. patens* var. *patentissimus*, while *A. georgianus* and *A. phlogifolius* are often copiously glanduliferous on the upper branches and peduncles.

LEAVES. The basal leaves in *Aster* section *Patentes* are somewhat spatulate, with *A. georgianus* producing the narrowest and *A. phlogifolius* the largest, most serrate basal leaves in the group. The cauline leaves are ovate to lanceolate, with the bases varying from auriculate-amplexicaul in *A. patens* and *A. phlogifolius* to only slightly clasping in *A. georgianus*. In shape and thickness the leaves of *A. georgianus* closely resemble those of *A. grandiflorus* in the related section *Grandiflori*.

The leaves of *A. phlogifolius* average nearly twice as long as those of *A. patens*, but there is so much overlap that this character is not reliable in separating the taxa. Leaf texture and pubescence provide better differences. *Aster phlogifolius* leaves are very thin, wrinkly-rugose, and soft-pubescent,

unlike the unwrinkled, thicker, and scabrous leaves of *A. patens* (Figure 2). These leaf differences persist in transplants, and are evident even in the first few cauline leaves of young seedlings. Leaf textural differences are also useful in distinguishing herbarium specimens of *A. patens* and *A. phlogifolius*, as described in the systematic treatment.

The leaves of *A. georgianus* and *A. patens* are similar in texture and size, although those of the former tend to be more lanceolate, less clasping and thicker, with only a few diffuse veinlets on the lower surface, unlike the fine reticulum of veinlets on *A. patens* leaves. The veinlets are even more diffuse in the leaves of the dodecaploid *A. grandiflorus*.

The difference in ploidy level between these groups is also evident in epidermal cell size. The larger epidermal cells of *A. georgianus* and *A. grandiflorus* produce a very thick epidermis that will peel away easily in large sheets, while the smaller-celled, and more fragile epidermis of *A. patens* tends to shred when peels are removed. For numerical comparisons, epidermal guard cell pairs were measured in five populations each of diploid *A. patens*, tetraploid *A. patens*, and decaploid *A. georgianus* (R. Jones, 1980, *t.* 11). On the basis of length and width measurements, in microns, of 10 guard cell pairs per leaf, one leaf per plant, and 10 plants per population, the means and ranges were as follows: diploid *A. patens*— 22×17 (16×13 to 29×24); tetraploid *A. patens*— 27×20 (19×16 to 36×26); and decaploid *A. georgianus*— 37×30 (24×23 to 45×39). A similar study of two populations of *A. grandiflorus* revealed that the guard cell pairs of these dodecaploids average, in microns, 44×30 , and range from 36×24 to 55×39 .

These same size relationships were found to exist in the epidermal guard cells of transplants, seedlings, and even in cotyledons (cotyledon guard cells are much larger than those of cauline leaves). In addition, numerous observations suggest that the number of chloroplasts in these guard cells also varies with the ploidy level, usually 6–8 per cell in diploids, 8–12 in tetraploids, and 12–18 in the decaploids and dodecaploids.

INVOLUCRES. The phyllaries of the *Patentes* occur in from 3–7 series, forming a campanulate to turbinate involucre. The middle phyllaries provide the best taxonomic characters. Variation in the *Patentes* occurs in phyllary size, shape, pubescence, herbaceousness, and in involucre height and shape.

The patterns of involucre variation in *A. patens* are nearly continuous, but there are regional differences in involucre height, phyllary width, and phyllary pubescence, which persist in transplants and seedlings, and thus are assumed to have a genetic basis. Plants in the Interior Highlands tend to have taller involucres with wider, more canescent phyllaries, and are here treated as the var. *patentissimus* (Figures 3, 4). The variety *gracilis* is that group of plants in the southwestern range of the species with shorter involucres and more strigillose phyllaries (Figures 3, 4). Typical *A. patens*

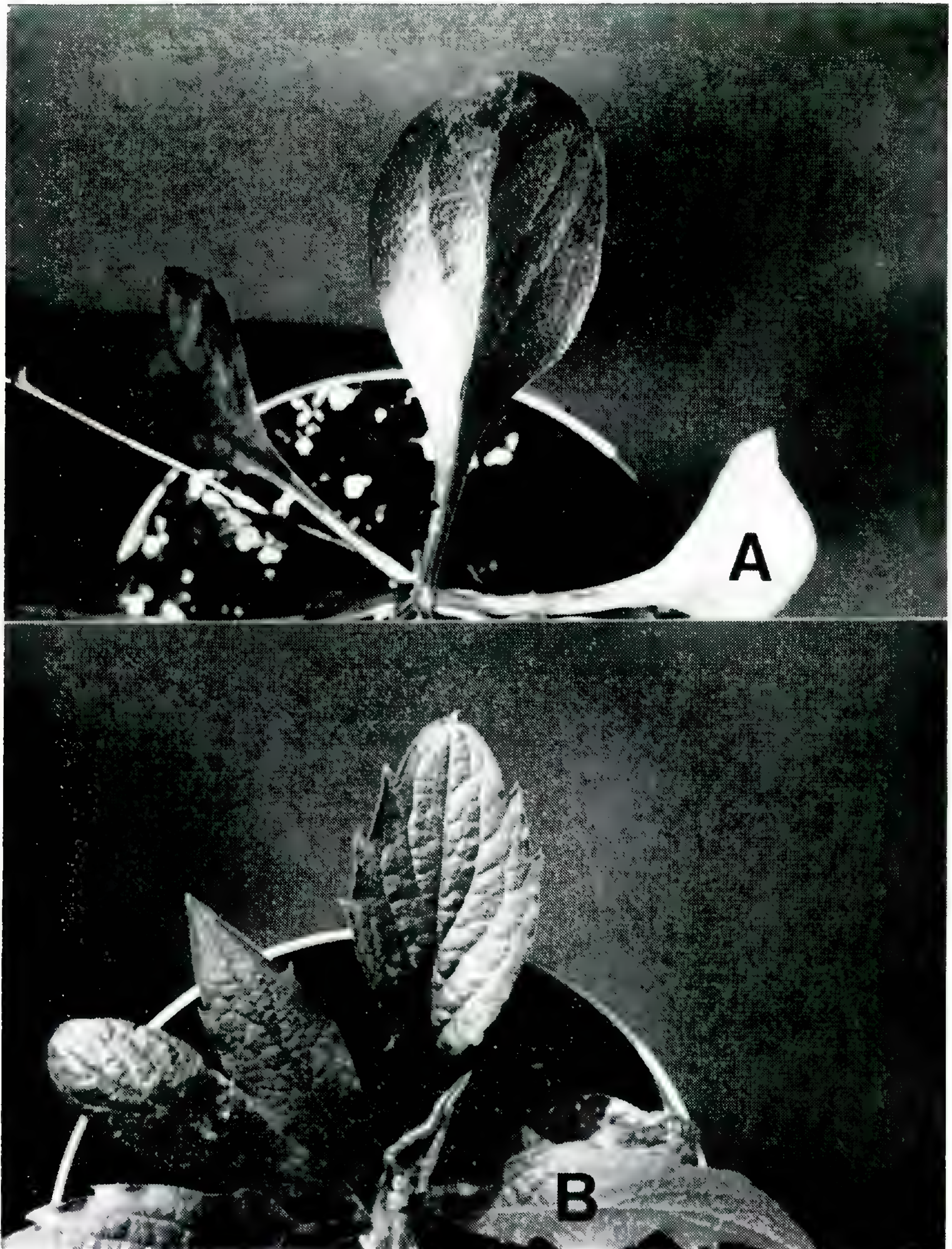


Figure 2. Photographs of seedling basal leaf rosettes of *Aster patens* (A) and *Aster phlogifolius* (B).

of the eastern United States has a campanulate involucre with squarrose, heavily glandular phyllaries (Figures 3, 4).

The involucre also provides species differences in the *Patentes*. In contrast to *A. patens*, the phyllaries of *A. phlogifolius* are loosely imbricated,

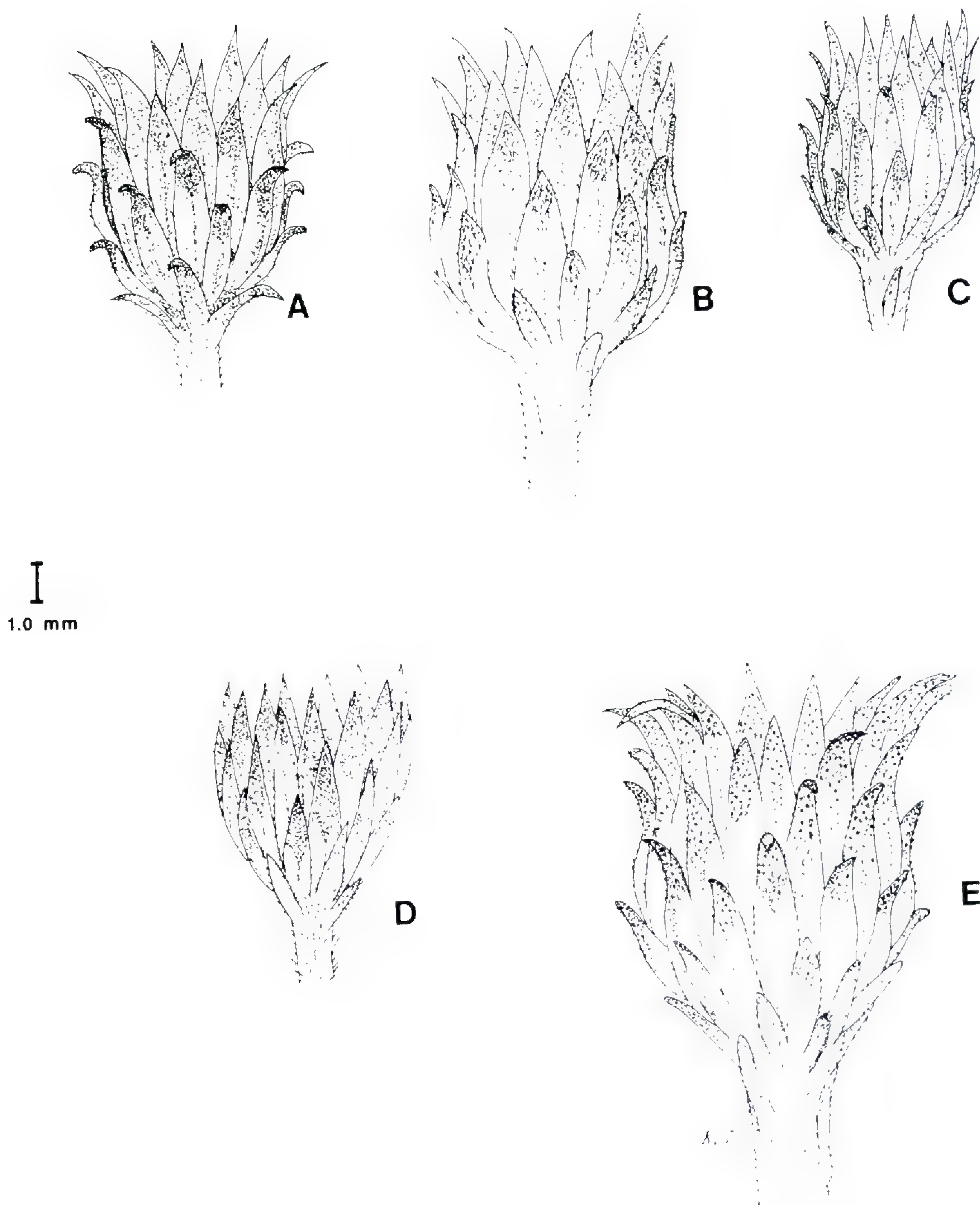


Figure 3. Representative involucre of *Aster patens* var. *patens* (A), *Aster patens* var. *patentissimus* (B), *Aster patens* var. *gracilis* (C), *Aster phlogifolius* (D), and *Aster georgianus* (E).

largely herbaceous, appressed, and glabrate (Figures 3, 5). The involucreal differences between *A. patens* and *A. georgianus* are largely those of size. In population studies, the involucreal height of diploid *A. patens* averaged 5.7 mm (ranging from 4.5–7.1), that of tetraploid *A. patens* averaged 6.4 mm (ranging from 4.8–8.0), and that of *A. georgianus* averaged 9.0 mm (ranging from 7.8–12.0). As illustrated in Figures 3 and 5, the phyllaries of *A. georgianus* tend to be even more squarrose and more glandular than are those of *A. patens*. The involucre of *A. georgianus* thus approaches that of *A. grandiflorus* in phyllary size and curvature, and these two high-polyploid species are often confused.

FLORETS. As shown in Figures 6 and 7, the disc corollas of *A. phlogifolius* tend to be a little longer, with a more expanded limb and larger lobes, when compared to those of *A. patens*. The largest florets in the group occur in *A. georgianus*, in which the ligules often exceed 2 cm and the disc corolla 1 cm (Figure 8). Total floret number averages fewest in *A. phlogifolius*, with less than 40 florets per head, while the other two species average closer to 50, but there is much overlap.

The best floret difference between the three species is disc corolla color. In *A. patens* the disc corolla is yellow, while in the other two species the disc corolla is white, often with purplish lobes. Evidently these color differences have a genetic basis, for they are maintained in transplants and in plants raised from achenes. In the field, these color differences are very consistent; rarely, *A. patens* may produce a whitish disc, but I have yet to find a yellow disc in populations of the other two species. In addition, the yellow disc florets of *A. patens* develop yellow anthers and yellow pollen, while in *A. phlogifolius* and *A. georgianus* the white disc corolla is associated with purplish anthers and whitish pollen. Pollen grain size varies with the ploidy level, averaging about 23 μm in diploid *A. patens*, 25 μm in tetraploid *A. patens*, and 30 μm in decaploid *A. georgianus* (R. Jones, 1980, *t.* 14).

Ligule color in the group varies from nearly white to an intense violet, and can be considerably influenced by the environment. Sporadic pink-liguled plants of *A. patens* occur in the field, but when transplanted produce the normal purplish rays. White-liguled plants occur occasionally in Texas, but the basis of this color difference is yet to be determined.

As measured across the rays, the overall head size in the group varies from about 2.5–3.5 cm in *A. patens* to 5 cm or more in *A. georgianus*. The difference in head size between *A. patens* and *A. georgianus* is usually much more dramatic in greenhouse plants. In cultivation, plants of *A. georgianus* often surpass 1.5 cm in involucreal height and 6 cm across the rays, reaching even larger dimensions than *A. grandiflorus*, and possibly the largest head size in the entire genus. Only under very stressful conditions will *A. georgianus* produce heads similar in size to those of *A. patens*.

ACHENES. The achene of *A. patens* is usually gray to brown, with paler

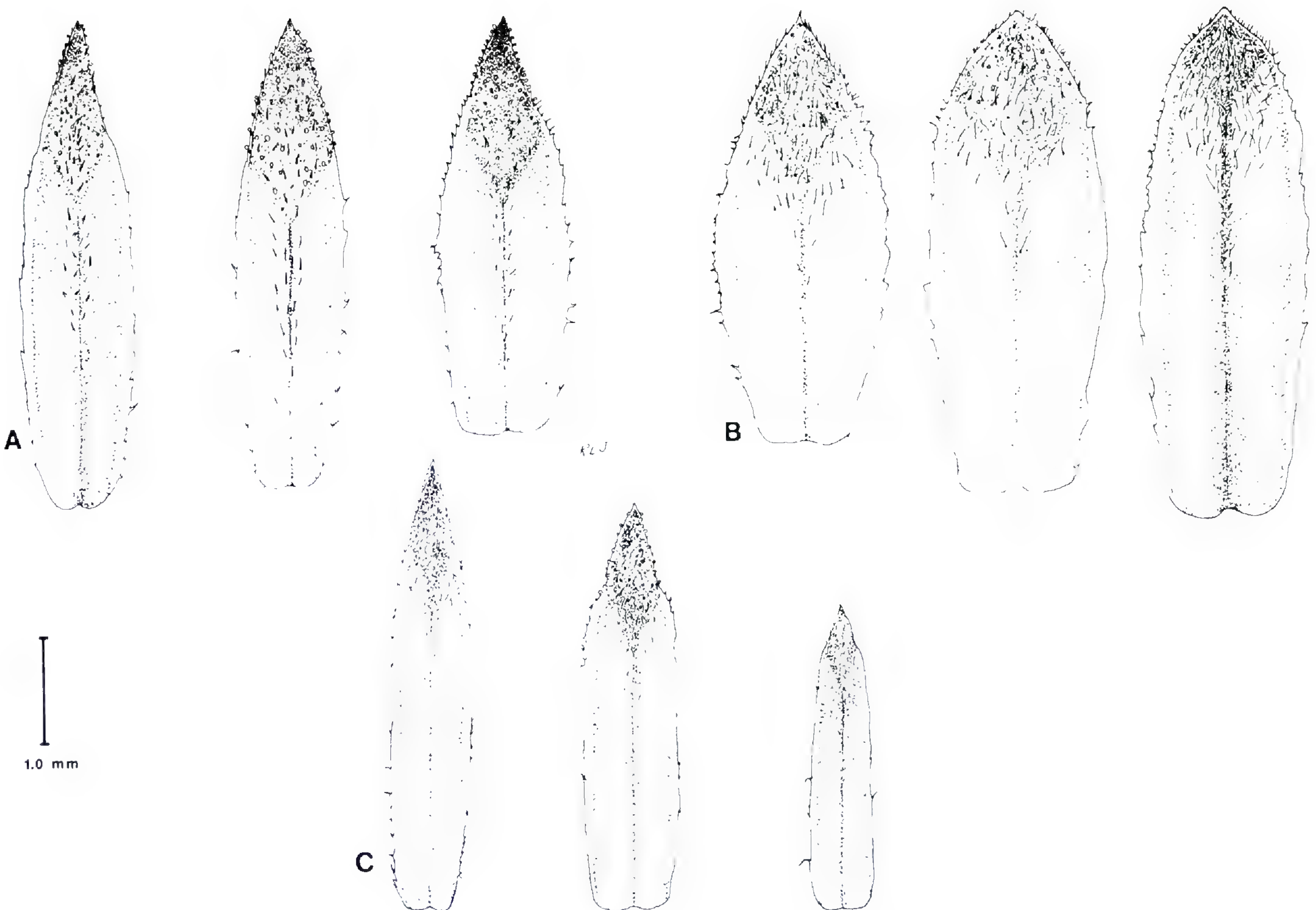


Figure 4. Representative middle phyllaries of *Aster patens* var. *patens* (A), *Aster patens* var. *patentissimus* (B), and *Aster patens* var. *gracilis* (C).

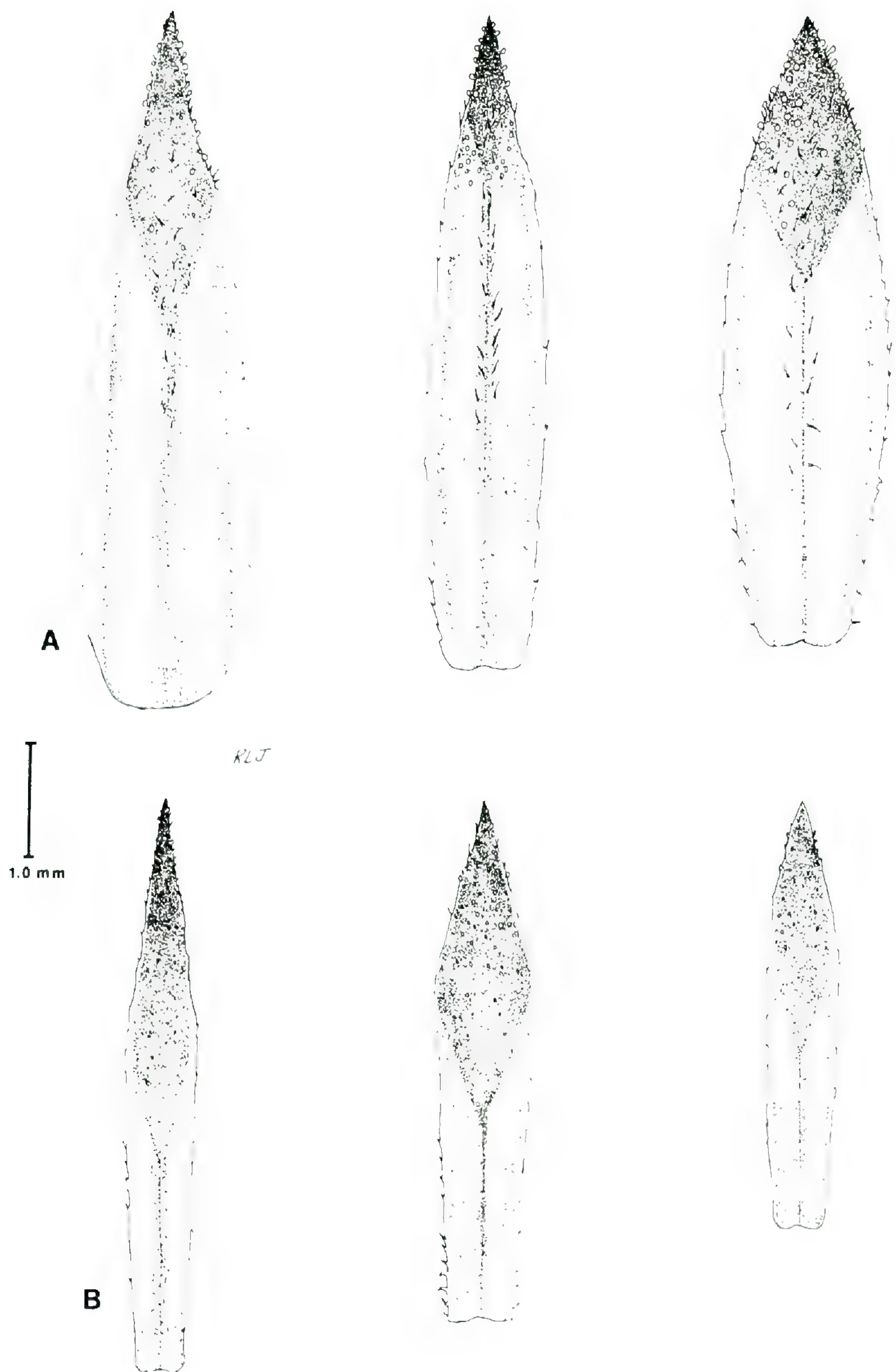


Figure 5. Representative middle phyllaries of *Aster georgianus* (A) and *Aster phlogifolius* (B).

ribs and evenly distributed, somewhat spreading trichomes (Figure 6). The achenes of *A. georgianus* are similar, but more slender and longer (Figure 8). In *A. phlogifolius*, however, the achenes are uniquely different. They are prominently ribbed, bulkier, nearly black, and with the trichomes very short, densely appressed, and restricted to the ribs (Figure 7). The pubescence thus appears to be in whitish lines on the dark achene of *A. phlogifolius*.

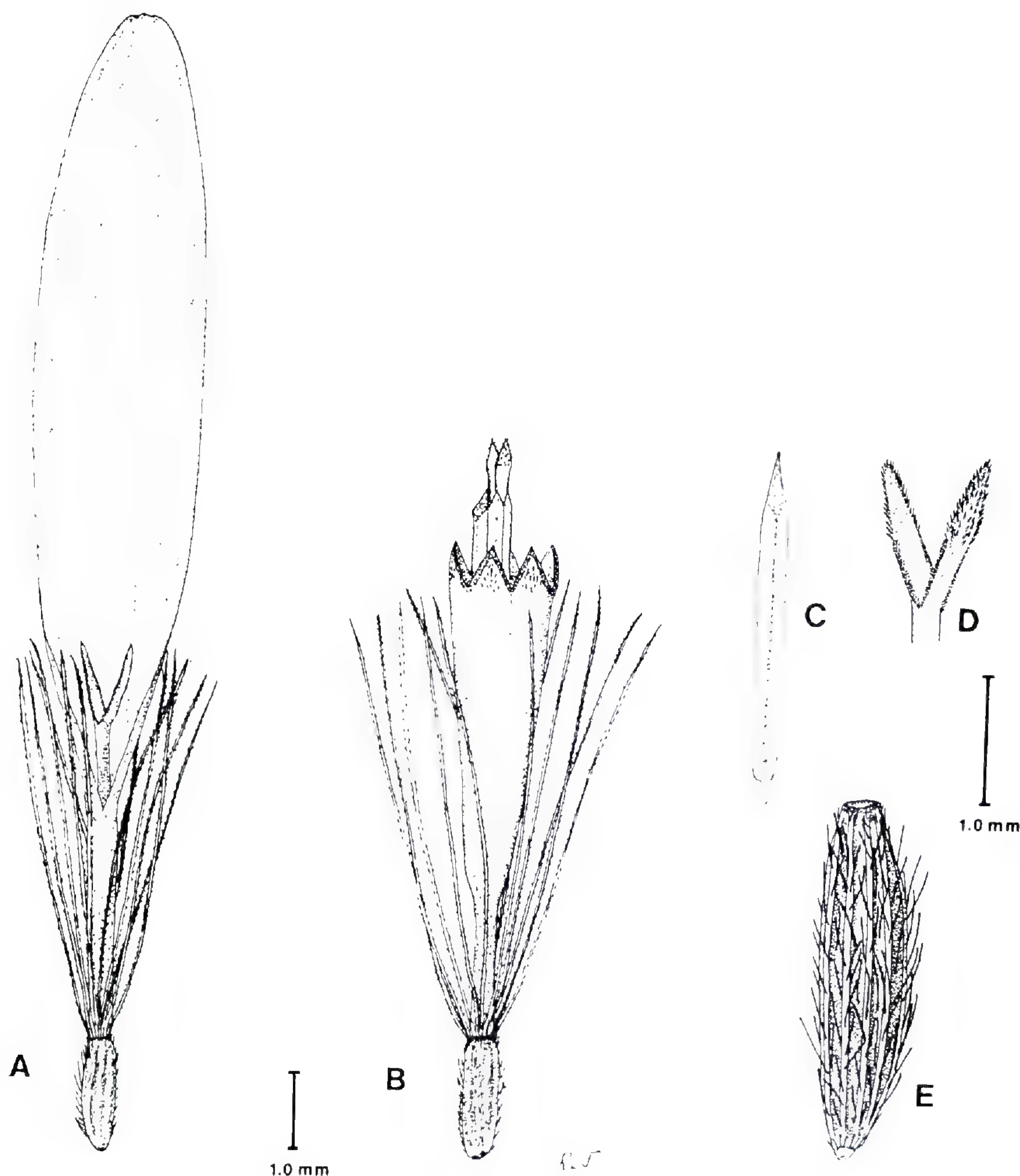


Figure 6. Representative ray floret (A), disc floret (B), anther (C), disc stigmatic branch (D), and achene (E) of *Aster patens*.

CROSSING STUDIES

A tabular presentation of the results of 394 crosses is given in my dissertation (R. Jones, 1980, *t.* 17). To summarize, the crosses within ploidy levels were relatively successful (20–40% average seed set), while crosses between ploidy levels were much less successful (less than 5%), except in the case of the high polyploids.

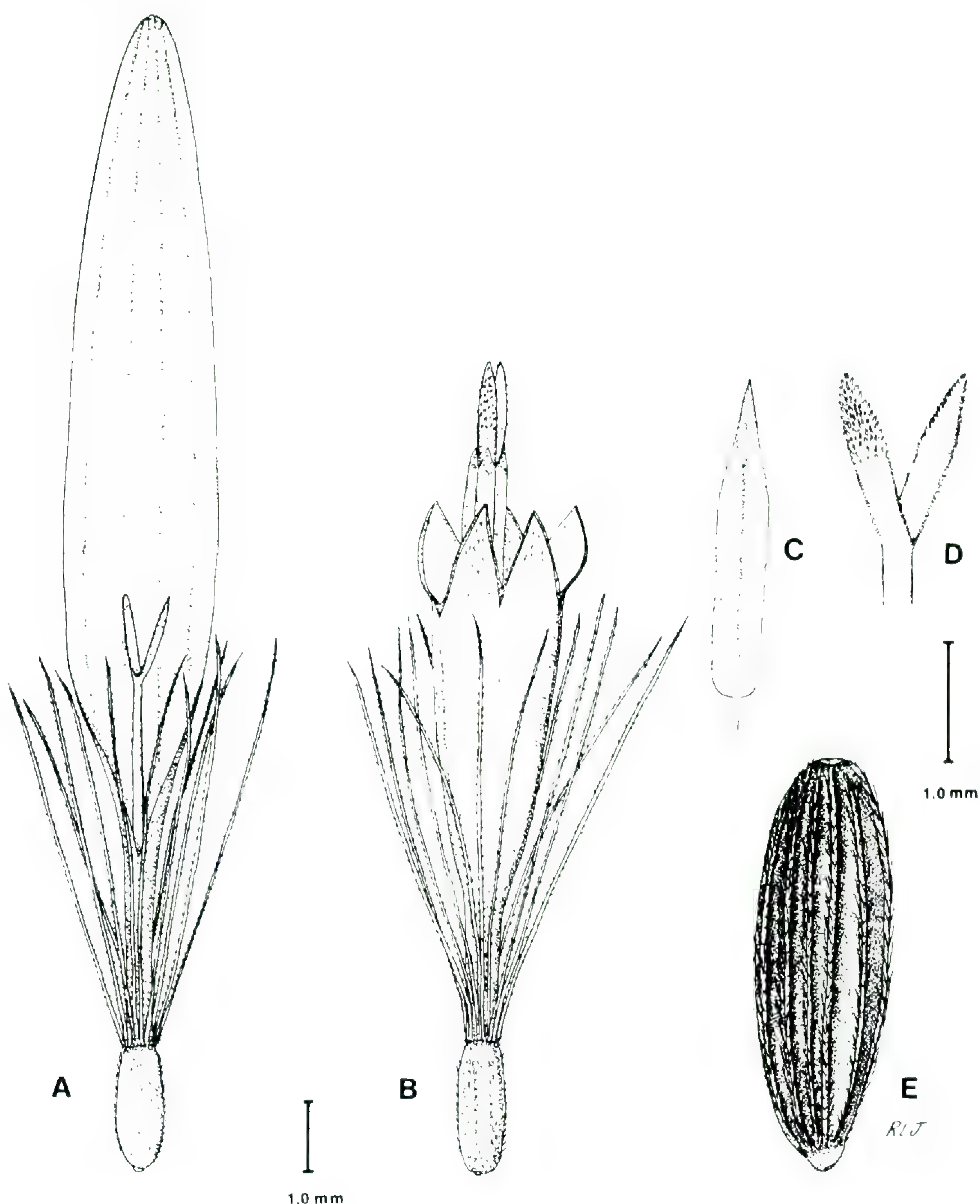


Figure 7. Representative ray floret (A), disc floret (B), anther (C), disc stigmatic branch (D), and achene (E) of *Aster phlogifolius*.

The crossing program demonstrated a good degree of genetic compatibility between tetraploid *A. phlogifolius* and tetraploid *A. patens*—crosses between the taxa were just as successful as crosses within the taxa. Hybrid achenes produced plants with intermediate morphologies. Likewise, the

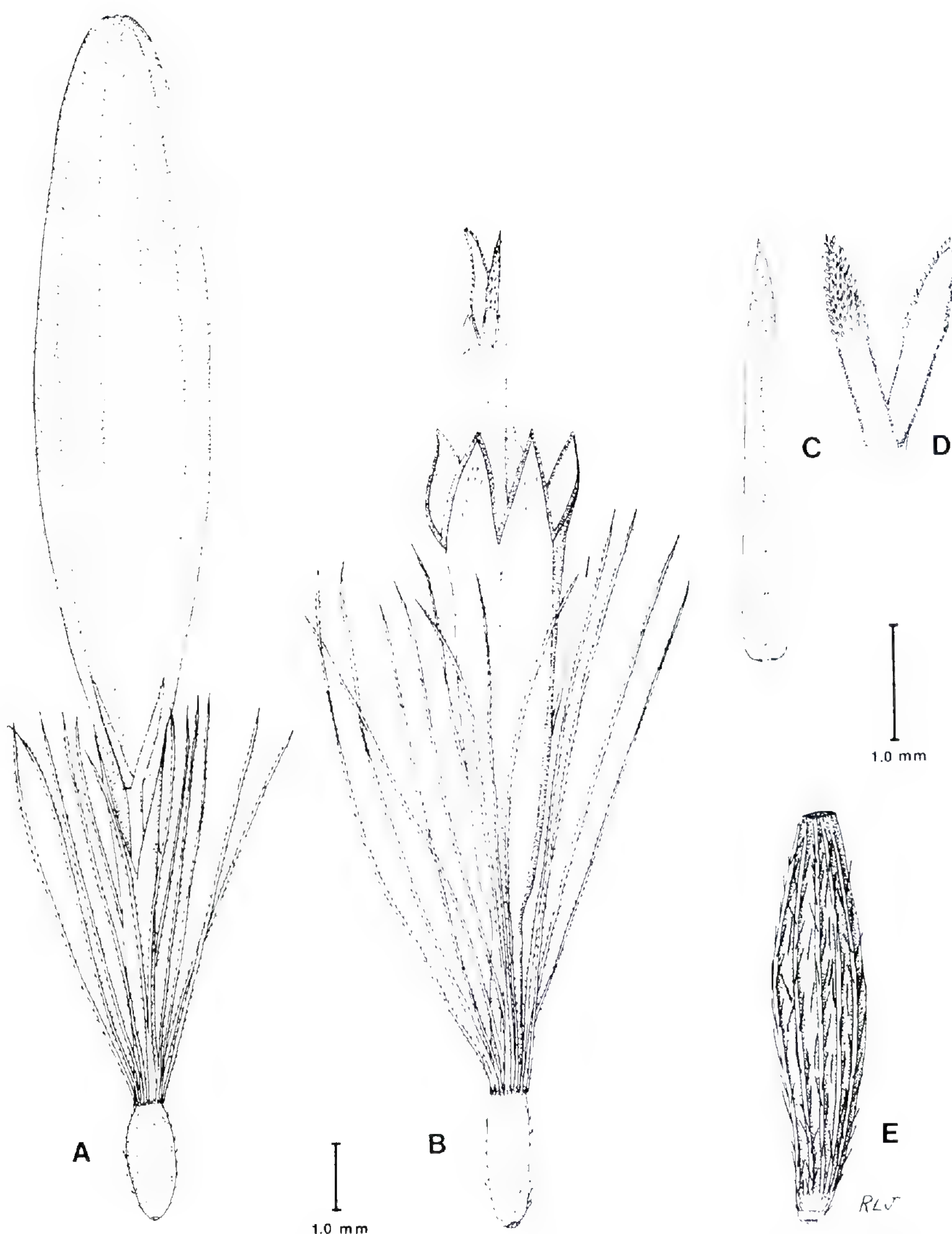


Figure 8. Representative ray floret (A), disc floret (B), anther (C), disc stigmatic branch (D), and achene (E) of *Aster georgianus*.

tetraploid crosses between the varieties *patens* and *patentissimus* of *A. patens* also produced good seed sets, and the hybrid offspring were intermediate in morphology. Only a few crosses were attempted between diploid and tetraploid *A. patens*, and none of these were successful.

Barriers to hybridization were also apparent in the 10 *A. patens* $\times$ *A. georgianus* and 15 *A. patens* $\times$ *A. grandiflorus* crosses; only a few achenes were produced in these crosses, and none would germinate. One of the more surprising aspects of the crossing studies was the degree of success in hybridizations between *A. georgianus* and *A. grandiflorus*, in which 11 crosses produced an average seed set of 20%. Some of these hybrid achenes were germinated, and they persisted for a while as seedlings rosettes, but did not bolt.

ECOLOGY AND DISTRIBUTION

The members of *Aster* section *Patentes* are woodland plants of the eastern United States. Like other perennial asters, they are genetically self-sterile and insect-pollinated, over-wintering as rosettes, bolting in the spring, and flowering in the fall. Peak flowering occurs in late September in *A. phlogifolius*, in early October in *A. patens*, and in late October in *A. georgianus*. Pollination is effected by a number of insects, including bees, butterflies, moths, and beetles. The achenes mature about one month after pollination and seed set is high. Achenes germinate readily in *A. georgianus* and *A. patens* (both upland and lowland populations), but the achenes of *A. phlogifolius* will germinate well only if stratified.

ASTER GEORGIANUS. Of the three species in the *Patentes*, *A. georgianus* is by far the most limited in distribution, occurring only from eastern North Carolina to central Alabama. These decaploid populations occur very infrequently through this region, and are found primarily in oak-pine woodlands in clay-loams or sandy-clays. At four sites in the St. Clair-Etowah County region of Alabama, I found mixed populations of *A. georgianus* and tetraploid *A. patens*. These plants were often completely intermixed, with individuals of each species growing side by side. In these situations the decaploids are easily distinguished by their colonial habit, much larger heads, deep-violet rays, and white discs. The difference in flowering period is very noticeable in these mixed populations when, in late October, *A. patens* is finishing its flowering period and *A. georgianus* is just coming into full bloom. There was no evidence of natural hybridization between the two ploidy levels in these mixed populations.

The range of *A. georgianus* meets that of *A. grandiflorus* in the Carolinas, and I have found populations of these species within a mile of each other in Montgomery County, North Carolina. The overlap in range and the similarity in habitat would thus offer opportunities for natural hybridizations. A few specimens of *A. georgianus* collected in this region did vary more toward *A. grandiflorus* than does typical *A. georgianus*.

ASTER PHLOGIFOLIUS. Populations of this species occur only in the Appalachians and adjacent regions, and are especially common in the mountainous areas of West Virginia, Virginia, Tennessee, North Carolina, and Kentucky. *Aster phlogifolius* is a plant of cool, mesic, mixed-hardwood communities, mostly at elevations of 300 to 1000 meters. Because of different ecological preferences, *A. phlogifolius* and *A. patens* usually do not occur in mixed populations, although there may be some marginal population contact in the case of habitat disturbance. I located three such sites in the Cumberland Plateau region where both taxa were present. In these situations, in the area of disturbance, individuals of each species can be found growing side by side, with *A. phlogifolius* easily distinguished by its large rugose-veiny leaves, appressed phyllaries, and white disc. There were a few individuals at one site that appeared to be hybrids, but the populations remained distinct, and there was no evidence of introgression. Except for *A. patens*, no other base-5 aster was found in association with *A. phlogifolius*.

ASTER PATENS. There are reports of *A. patens* from every state east of the Mississippi River except Wisconsin, Michigan, Vermont, and Maine. West of the Mississippi River the species occurs in Louisiana, Arkansas, Missouri, Oklahoma, Kansas, and Texas. There is a single record of the species from near Ottawa, Canada, and from an unspecified location in Minnesota (possibly a label error). Herbarium records provide no evidence of *A. patens* in either Mexico or in southern Florida, although it has been reported from the latter region by Ledin (1951).

Populations of this species can be found in almost any upland, acidic, open woodland throughout its range, although less commonly on the outer Coastal Plain, and they occur on a variety of soils. Plants can be found on the dry sands of the Coastal Plain at or near sea level, and in more mesic situations in the Appalachian forests at elevations up to 1000 meters or more. *Aster patens* occurs on the red clays of Georgia, the Black Belt chalks of Alabama, and the prairie-transition soils of Oklahoma. Plants are most common in the full sun or partial shade of woodland borders, but also occur along roadsides, edges of fields, under power lines, and in other recently disturbed places. There is no obvious difference in habitat among the three varieties of *A. patens*.

The Mississippi Embayment forms a boundary line between var. *patens* in the east and var. *patentissimus* in the Interior Highlands. In these uplands one also encounters populations of typical var. *patens*, as well as populations of intermediate morphologies. Because both varieties are largely tetraploid, these intermediate plants are probably the result of natural hybridization.

Aster patens var. *gracilis* is a largely diploid group of the southwest, from western Alabama to Texas and Oklahoma. Occasional tetraploid populations, some indistinguishable from diploids, others more like the var. *patens* or the var. *patentissimus*, also occur within this range. No evidence was found for

the existence of diploid and tetraploid plants in the same population, although these ploidy levels were found in adjacent counties in western Alabama. Diploid plants are apparently absent from the Atlantic Coastal Plain.

Because diploid counts have been reported from only as far east as Sumter and Baldwin Counties in Alabama, a demarcation line must exist in south central Alabama beyond which diploids do not occur. According to Harper (1943), the western section of the Red Hills of Alabama is more fertile and receives more summer rain than does the eastern section. Garden and greenhouse studies have suggested that the diploids are less hardy than the tetraploids. Thus, perhaps the harsher conditions of the eastern Red Hills somehow have prevented the eastern migration of the less tolerant diploids onto the Atlantic Coastal Plain.

Because of habitat differences there are relatively few opportunities for *A. patens* to hybridize with base-5 asters from other sections. In field studies I have observed the following species of known or presumed base-5 asters in the vicinity of populations of *A. patens*—*A. novae-angliae*, *A. oblongifolius*, *A. adnatus*, *A. concolor*, and *A. pratensis*. Others to be expected include *A. grandiflorus*, *A. walteri* and *A. sericeus*. Only in the instance of contact with *A. oblongifolius* was there evidence of hybridization—a single individual in a population of *A. patens* var. *patentissimus* in Fulton County, Arkansas, varied toward *A. oblongifolius* in leaf and involucre. Hybrids between these two species have also been reported by Correll and Johnston (1970). Plants that Radford et al. (1968) described as intermediate between *A. patens* and *A. grandiflorus* are probably collections of *A. georgianus*. Other base-5 asters of the U. S. are inhabitants of grasslands, prairies, and coastal marshes, and thus would be less likely to come into contact with populations of *A. patens*.

SPECIES CONCEPT

The concepts of species and varieties followed in this study fall within the limits of the definitions proposed by Cronquist (1978). I have chosen to instate *A. georgianus* and *A. phlogifolius* to species rank because of the existence in these taxa of consistent morphological variation patterns involving readily observable features of the entire plant body (from rhizome to involucre to achene), which has a genetic basis (features retained in transplants, seedlings, and in mixed populations with *A. patens*), which are explainable by isolating mechanisms (ecological in *A. phlogifolius* and chromosomal in *A. georgianus*), and which are discontinuous with those of *A. patens*. Two other taxa, the var. *gracilis* and var. *patentissimus* of *A. patens*, are retained at the varietal level because the features are less consistent, are mostly restricted to the involucre, and show more continuity with the typical features of *A. patens* var. *patens*, but are based on genetic differences which have geographic correlations.

Crossing studies indicate that tetraploid *A. phlogifolius* and tetraploid *A. patens* will hybridize, but that diploid *A. patens* is incompatible with tetraploid *A. patens*. The section *Patentes* thus provides an excellent example of the taxonomic conflict encountered in *Aster* when morphological divergence has not been accompanied by reproductive divergence, and vice versa. In addition, *A. patens* and *A. georgianus* provide examples of groups in which both morphological and reproductive divergence have taken place. If priority were given to incompatibility relationships, then *A. phlogifolius* could not be recognized as a species, and the diploid plants in *A. patens* would have to be segregated as a distinct species. In neither instance would the resulting taxonomy reflect the comparative morphological differences that are actually observable in nature.

PHYLOGENY

The best clues to the evolutionary history of the *Patentes* are found in the cyto-geographic relationships. The distribution of the diploids (*A. patens* var. *gracilis*), which are presumably ancestral to the other taxa, suggests a southwestern, or possibly even a Central American origin of the group. A significant development in the evolution of the group was the appearance of tetraploid plants, which, with their greater ecological tolerance, could expand the range of the group to the east and the north. Geographic isolation of tetraploids in the Interior Highlands by the Mississippi Embayment would then account for the morphological divergence of *A. patens* var. *patentissimus*. *Aster phlogifolius* is apparently the result of ecological isolation of tetraploid populations in the mesic habitats of the Appalachians.

The origin of populations of *A. georgianus* with the perplexing chromosome number of $2n=50$ is at this point still unclear. The large gap in chromosome numbers between this group and the known ploidy levels in *A. patens* suggests that these colonial decaploids are not simple polyploid derivatives of diploids and tetraploids. Another fact to be considered is that, although *A. georgianus* is morphologically very similar to *A. patens*, there are also some resemblances to *A. grandiflorus*, especially in leaf and involucre. One hypothesis, then, is that some kind of crossing event between dodecaploid *A. grandiflorus* and tetraploid *A. patens* was involved in the ancestry of decaploid *A. georgianus*. A $2n$ number of 50 could be obtained from plants with $2n=60$ and $2n=20$ in several ways. For example, if a somatically reduced pollen grain of *A. grandiflorus* (15 chromosomes) fertilized a reduced egg of *A. patens* (10 chromosomes), then the offspring would have 25 chromosomes, which could then double to 50. With its intermediacies in leaf, involucre, and head size, a mature offspring of *A. patens* and *A. grandiflorus* would, in theory, look very much like *A. georgianus*.

Whatever their origin, these decaploids now behave as a species, with a distinct geographic range, chromosome number, and morphology. The evidence for the implication of *A. grandiflorus* is purely circumstantial, and

there are, of course, other possible explanations for the origin of these decaploid populations. In the absence of experimental verification, the ancestry of *A. georgianus* remains a mystery.

SYSTEMATIC TREATMENT

ASTER section *PATENTES* T. & G., Fl. N. Amer. 2: 114. 1841.

Lasallea Greene subsect. *Brachyphyllae* (T. & G.) Semple & Brouillet, Amer. J. Bot. 67: 1023. 1980. In part.

Virgulus Raf. section *Patentes* (T. & G.) Reveal & Keener, Taxon 30: 650. 1981.

Perennial herbs from a thickened caudex or a creeping rhizome. Stems, branches, and leaves pubescent with appressed to spreading, uniseriate, tapering trichomes, often glandular with biseriate, capitate trichomes. Rosette and lower stem leaves soon deciduous, obovate-spathulate to oblanceolate-spathulate, 5–12 cm long and 1–5 cm wide, acuminate to obtuse, mucronulate, entire-ciliate, or with a few scattered teeth, variously attenuated to a sheathing or clasping base, the surfaces strigose to pilose. Cauline leaves less than 30 below the inflorescence, ovate to ovate-oblong to lanceolate, 2–15 cm long and 1–4 cm wide, varying with the species, acuminate to obtuse, mucronulate, entire-ciliate or with a few teeth, sessile and cordate-clasping to auriculate-amplexicaul, texture and venation variable, surfaces soft-pubescent to scabrous. Inflorescences paniculiform to racemiform; peduncular bracts mostly 2–4 mm, much smaller than upper cauline leaves. Involucre campanulate to turbinate, 5–12 mm tall, the phyllaries imbricated in 3–7 series, gradually shortened from innermost to outermost, middle phyllaries linear-lanceolate to somewhat oblanceolate, acuminate to obtuse, entire to hyaline-fimbriolate; upper portion of the phyllary herbaceous and squarrose or appressed, the basal portion chartaceous-indurate, puberulent toward the apex and down the midvein with glandular and non-glandular trichomes, in varying amounts. Heads radiate, mostly 2–3 cm across the rays, up to 5 cm in one species, with 30–70 florets per head. Ray florets with pappus about 1/3 as long as the ligule; ligules lavender to deep-violet, sometimes pink or white. Disc florets with pappus nearly as long as the disc corolla; disc corolla yellow or white, depending on the species, the lobes often purplish, the whole corolla becoming so with age, the corolla differentiated into a narrow tube and broader limb with 5 triangular erect to spreading lobes. Stamens yellow or purplish, pollen yellow or white, both features varying with the species. Achenes light gray-brown to nearly black, 2–4 mm long, the longitudinal ribs often 10 or more, surfaces pubescent, the trichomes made up of two elongate, parallel cells, these restricted to the ribs in one species. $2n=10, 20, 50$, with occasional B-chromosomes in the diploids and tetraploids.

Distribution: Woodland borders and open places of the eastern United States.

TYPE SPECIES: *Aster patens* Ait. Hort. Kew. 3: 201. 1789.

KEY TO THE TAXA OF ASTER SECTION PATENTES

- 1. Plants colonial, the stems arising singly from elongate rhizomes. Leaves thick and scabrous, the veinlets diffuse on lower surface, or with areoles over 1 mm across, the leaf base only slightly clasping. Branches thick and strongly ascending. Involucre 8–12 mm tall, phyllaries both squarrose and glandular-strigillose. Disc florets 8–10 mm tall, white with purplish lobes, anthers purplish and pollen white. Heads over 4 cm across the rays.....1. *Aster georgianus*
- 1. Plants caespitose or with single stems arising from caudices, rarely with elongate rhizomes. Leaves various but with distinct reticulum on lower surfaces, the areoles less than 1 mm wide. Branches slender and spreading to ascending. Involucres and florets without the above set of features. Heads less than 4 cm across the rays.
 - 2. Cauline leaves large and thin, usually over 80 mm long, the upper surfaces rugose-veiny and wrinkled, when dried and magnified appearing smooth and dull, dark green, both surfaces softly pubescent. Involucres short-cylindric, phyllaries loosely imbricated in 3–4 series, appressed, over 50% green, glandular but not strigillose. Disc corollas and pollen white, anthers purplish. Achenes large, often over 3.5 mm long, dark brown to black, the trichomes less than 0.4 mm and restricted to the ribs, the pubescence thus appearing to be in lines 2. *Aster phlogifolius*
 - 2. Cauline leaves usually less than 80 mm long, the leaves thick, venation inconspicuous, the surfaces appearing ridged and glistening when dried and magnified, scabrous. Involucre campanulate to turbinate, phyllaries in 4–7 series, either squarrose and strigillose or appressed and canescent, largely indurate. Disc corollas, anthers, and pollen yellow. Achene slender, gray to brown, the trichomes long and ascending, occurring both on and between the ribs. 3. *Aster patens*
 - 3. Involucres turbinate, usually over 8 mm tall, the phyllaries often in 5–7 series, over 1.2 mm wide, obtuse, appressed, sparsely glandular to eglandular, densely strigillose to canescent 3c. *Aster patens* var. *patentissimus*
 - 3. Involucres campanulate, less than 8 mm tall, phyllaries in 4–5 series, less than 1.2 mm wide, acute to acuminate, sparsely to densely glandular, sparsely to densely strigillose.
 - 4. Plants slender, long-branches, with involucres less than 6.5 mm tall, the phyllaries sparsely glandular and densely strigillose 3b. *Aster patens* var. *gracilis*
 - 4. Plants more robust, involucres often over 6.5 mm tall, the phyllaries densely glandular and sparsely strigillose.....3a. *Aster patens* var. *patens*

1. ASTER GEORGIANUS Alexander in Small, Man. Fl. SE. U.S., 1381. 1933.
Aster patens Ait. var. *georgianus* (Alexander) Cronquist, Brittonia 29: 218. 1977.
Virgulus patens (Ait.) Reveal and Keener var. *georgianus* (Alexander ex Small) Reveal and Keener, Taxon 30: 650. 1981.

Plants colonial, with new stems arising singly at some distance from the old stem bases. Underground stems elongate and creeping, the rhizomes usually lacking a caudiciform portion. Stems, branches, and leaves scabrous with stiff, swollen-based, ascending trichomes, often copiously glanduliferous. Stems erect, branches few, thick and strongly ascending. Cauline leaves lanceolate to oblanceolate, 30–70 mm long and 10–20 mm wide, the bases narrowed and only slightly cordate-clasping; leaves very thick, upper surface in fresh material with inconspicuous lateral venation, appearing ridged and

glistening when dried and magnified, veinlets diffuse on lower surface, the reticulum indistinct or the ultimate areoles less than 1 mm in diameter, the epidermal layer thick and peelable in large sheets. Inflorescences narrowly racemiform or paniculiform, with one or a few heads at ends of ascending branchlets; peduncles sometimes over 10 cm long, the peduncular bracts squarrose to spreading. Involucres turbinate, 8–10(–12) mm tall, the phyllaries 30–50, tightly imbricated in 4–7 series, strongly squarrose, middle phyllaries broadly lanceolate-linear, 5–7 mm long and 1.0–1.7(–2.0) mm wide, acuminate to acute, ciliate to fimbriolate, less than 50% green, both glandular and strigillose. Heads 4–5(–6) cm across the rays, with usually 12–24 ray florets and 20–40 disc florets. Ligules lavender-violet to haematoxylin-violet, 14–24 mm long; disc corollas white with purplish lobes, 7–10(–11) mm long; anthers purplish, mostly 3–4 mm long, the pollen whitish; styles often conspicuously exerted, the appendaged stigmatic branches 1.5–2.5 mm long. Achenes pale gray-brown, slender, 2.5–4.0 mm long, trichomes over 0.4 mm long, scattered both on and between the ribs. $2n=50$. Figure 9.

Distribution (Figure 10). Oak-pine flatwoods and uplands, especially Piedmont, from North and South Carolina into Georgia and Alabama. Early October to middle November.

TYPE: GEORGIA. Richmond Co.: Augusta, 10 Oct 1898, *Cuthbert* (HOLOTYPE: NY!).

Cronquist (1977), in proposing varietal status, noted that both these large-headed plants and typical *A. patens* occur in similar habitats and that "The nature of the population structure and breeding-behavior that permits this group to retain its identity under such conditions remains to be determined." The present study clarifies both the morphological basis for the recognition of the taxon as a distinct species and the nature of the breeding system that maintains these differences.

Because of head size and leaf shape, *A. georgianus* has sometimes been mistaken for *A. grandiflorus*, or for a hybrid between this dodecaploid species and *A. patens*. In contrast to *A. georgianus*, however, *A. grandiflorus* has a more cespitose habit, with narrower, less clasping leaves, hispid pubescence, abruptly spathulate and foliaceous phyllaries, and yellow disc flowers. Because of range overlap, as well as similarity in chromosome number, there is a possibility that some natural hybridization could take place between these two high-polyploid base-5 asters in the Carolinas.

Herbarium records provide evidence of *A. georgianus* in only 21 counties in the southeastern United States; collections during this study have added four additional counties. All of these records are from the four contiguous Piedmont states, with the exception of a single collection from northern Florida, and a dubious, mixed collection from Louisiana. Despite extensive searches, I was able to find this species at only nine sites, four in Alabama,

one in Georgia, one in South Carolina, and three in North Carolina. *Aster georgianus* is thus an uncommon plant throughout its limited range, and is perhaps deserving of consideration as a threatened or endangered species.



Figure 9. Holotype of *Aster georgianus* Alexander in Small.

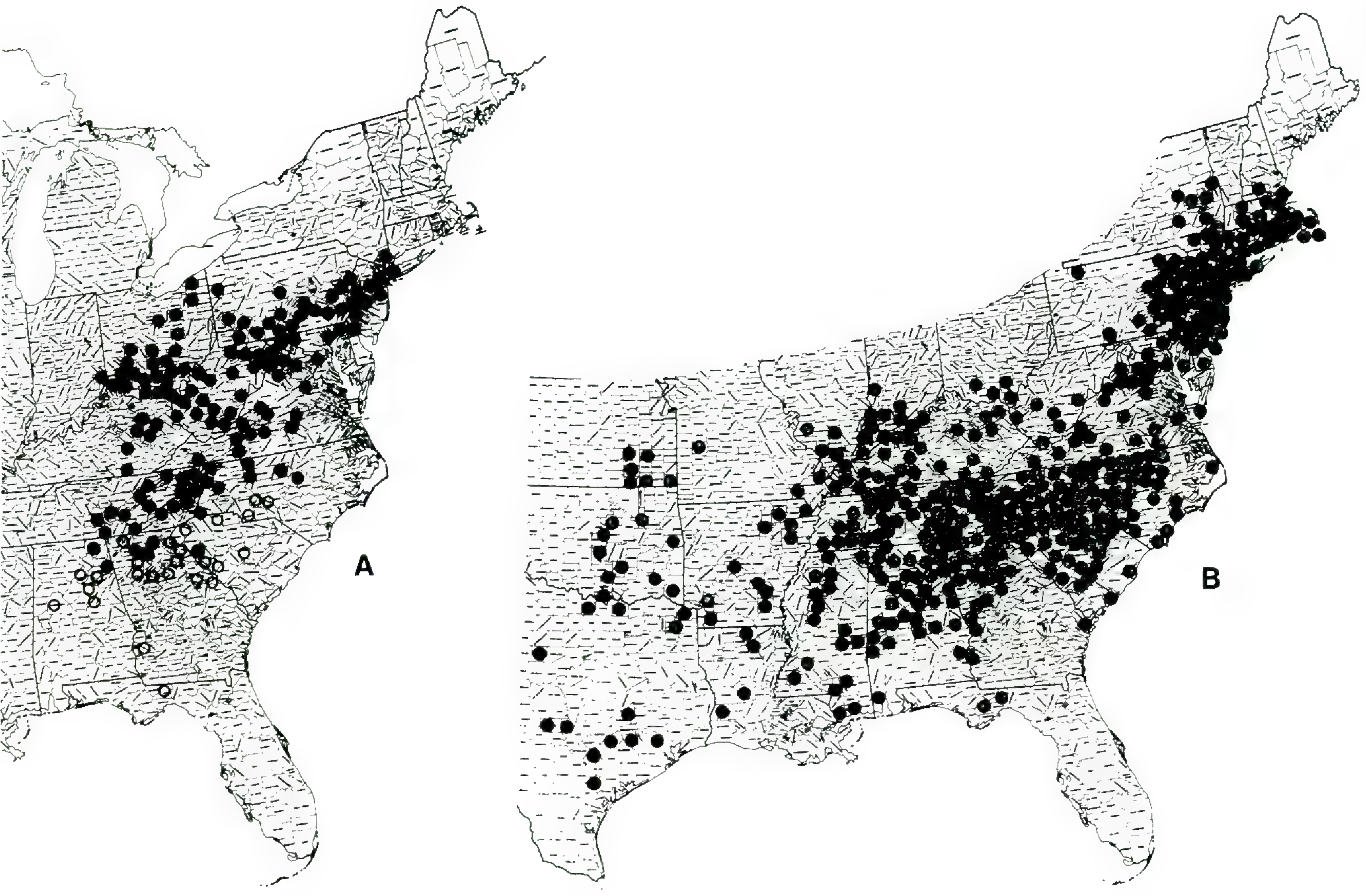


Figure 10. Map A. Distribution of *Aster georgianus* (open circles) and *Aster phlogifolius* (solid circles). Map B. Distribution of *Aster patens* var. *patens*.

2. ASTER PHLOGIFOLIUS Muhl. ex Willd., Sp. Pl., ed. 4, 3: 2034. 1803.

Aster patens Ait. var. *phlogifolius* (Willd.) Nees, Gen. Sp. Aster., 49. 1832.

Aster auritus Lindl. in DC., Prod. 5: 232. 1836. TYPE: An English cultivar of unknown origin, *Lindley* (ISOTYPE: CGE!).

Virgulus patens (Ait.) Reveal & Keener var. *phlogifolius* (Muhl. ex Willd.) Reveal & Keener, Taxon 30: 650. 1981.

Plants solitary-stemmed, or occasionally cespitose, the new stems arising at or near the old stem bases. Underground stem a caudex, short and thickened, not rhizomatous. Stems, branches, and leaves soft-pubescent with slender-based, ascending to spreading trichomes, often copiously glanduliferous. Stems tall and arching, branches few and short, occurring mostly toward the summit. Cauline leaves ovate-lanceolate to panduriform, 75–125 (–140) mm long and 15–35 (–40) mm wide, acute to acuminate, strongly cordate-clasping to auriculate-amplexicaul; leaves very thin, almost membranous, upper surface in fresh material rugose-veiny and wrinkled, appearing smooth and dull, dark green between the veinlets when dried and magnified, the veinlets finely reticulate on the lower surface. Inflorescences narrowly racemiform, the heads short-peduncled and often crowded along the arching branchlets; peduncles less than 4 cm long, peduncular bracts appressed. Involucres short-cylindric, 5.5–7.5 (–8.0) mm tall, the phyllaries 20–35, loosely imbricated in 3–4 series, appressed, middle phyllaries narrowly linear, 3.5–5.5 mm long, 0.7–1.1 mm wide, acute to acuminate, mostly entire, over 50% green, glandular but not strigillose. Heads less than 4.0 cm across the rays, with usually 9–17 ray florets and 15–35 disc florets. Ligules lavender-violet to haematoxylin-violet, 10–18 (–20) mm long; disc corollas white with purplish lobes, 6–8 mm long; anthers purplish, 2–3 mm long, the pollen whitish; styles often conspicuously exerted, the appendaged stigmatic branches 1.5–2.0 mm long. Achenes dark brown to black, bulky, 2.5–4.0 mm long, trichomes less than 0.4 mm long, and appressed, occurring mostly on the ribs, and the pubescence thus appearing in lines. $2n=20$. Figure 11.

Distribution (Figure 10). Rich, mesic, mixed-hardwood forests of the Appalachians, from southeastern New York to northeastern Alabama. Late August to middle October.

TYPE: PENNSYLVANIA. *Muhlenberg* (HOLOTYPE: B, photograph!; possible ISOTYPE: PH!).

Torrey and Gray, in 1841, followed Nees in treating this plant as a variety, but remarked that they were “strongly disposed to consider it a distinct species; but are now convinced by the examination of numerous intermediate forms, that it is a state which the plant assumes in shady moist places.” Most later authors have accepted this concept, viewing Appalachian taxon as a shade form or sylvan race of *A. patens*, and deserving of no more than varietal status. This “shade morphology,” however, can now be shown to be based on genetic differences, and to be reliable enough for



Figure 11. Holotype of *Aster phlogifolius* Muhl. ex Willd. Photograph courtesy of Botanischer Garten und Botanisches Museum, Berlin.

consistent identification of *A. phlogifolius*.

Mesic forms of *A. patens*, with their larger leaves and more racemiform inflorescence, are often misidentified as *A. phlogifolius*. The key differences between these taxa, however, involve leaf texture and pubescence, phyllary texture and pubescence, disc color, and achene pubescence, and the more mesic forms of *A. patens* remain distinguishable from *A. phlogifolius* on the basis of these characters.

Aster patens and *A. phlogifolius* in the Appalachians are tetraploid, and some natural hybridization can be expected in the event of population contact; these opportunities for hybridizations usually occur as a result of habitat disturbance. In most cases, populations of these two taxa are ecologically isolated, and even if there is contact, it is usually only marginal, and the populations remain clearly discernable.

Aster phlogifolius frequently occurs on rich, rocky, loamy, slopes, often above small streams, along and within the forest edge, in full or partial shade. In these situations, the plants are very attractive, with tall, arching, leafy stems, and apical clusters of crowded, deep-violet heads. It is an inhabitant of mature forest lands, and reacts poorly to disturbance; if the canopy is removed and the plants exposed to full sunlight, most will die.

3a. *ASTER PATENS* Ait. var. *PATENS* Hort. Kew. 3: 201. 1789.

Aster amplexicaulis Michaux, Fl. Bor.-Amer. 2: 114. 1803, *non* Lamarck (1783), *nec* Muhl. ex Willd. (1803). TYPE: AMERICA. Carolina. Michaux (ISOTYPES (3): P!).

Aster patens Ait. f. *rosea* Svenson, Rhodora 37: 263. 1935. TYPE: "New York, Oct 11, 1931," Svenson 4727, in Brooklyn Botanic Garden Specimen not seen.

Lasallea patens (Ait. Semple & Brouillet, Amer. J. Bot. 67: 1023. 1980.

Virgulus patens (Ait.) Reveal & Keener, Taxon 30: 650. 1981.

Plants caespitose, with new stems arising in clusters at or near the old stem bases. Underground stem a caudex, or occasionally with short rhizomes. Stems, branches, and leaves scabrous with stiff, swollen-based, ascending trichomes. Stems ascending to erect, branches many, slender, and divaricately spreading. Cauline leaves ovate to oblanceolate, (20-)30–70(-90) mm long and 10–30(-40) mm wide, acuminate to obtuse, the base broadened and cordate-clasping to auriculate-amplexicaul; leaves thick, upper surface in fresh material with inconspicuous lateral venation, appearing ridged and glistening when dried and magnified, the veinlets on the lower surface forming a distinct reticulum with ultimate areoles often less than 0.5 mm across. Inflorescences usually paniculiform, with one or a few heads at ends of spreading branchlets; peduncles short to elongate, often over 10 cm long, the peduncular bracts appressed to squarrose. Involucres campanulate, 5.5–7.5 (-8.5) mm tall, the phyllaries 25–45, tightly imbricated in 4–6 series, squarrose, middle phyllaries linear to lanceolate, 3.5–5.5 mm long and 0.8–1.2(-1.5) mm wide, acuminate to acute, ciliate to fimbriolate, less than

50% green, strigillose, but prevailingly glandular, the capitate trichomes large and conspicuous at 30 $\times$. Heads less than 4 cm across the rays, and usually 12–24 ray florets and 20–50 disc florets. Ligules pale lavender to pleroma violet or mauve, sometimes white or pink, 10–18(-20) mm long; disc corollas yellow, paler toward the base, rarely whitish, 5.5–7.5 mm long; anthers yellow, 2–3 mm long, the pollen yellow; styles only slightly surpassing the corolla, the appendaged stigmatic branches 1.0–1.5 mm long. Achenes tan to dark-brown or grayish, slender, 2.0–3.5 mm long, the trichomes scattered both on and between the ribs, usually over 0.4 mm long and spreading. $2n=20$, 10. Figure 12.

Distribution (Figure 10). Dry woodland borders and open places, especially oak-pine and oak-hickory, throughout much of the eastern United States, less frequent on the outer Coastal Plain and in the ranges of the other two varieties. Late August to early November.

TYPE: A cultivated specimen from the Chelsea Physic Garden, *Miller* (HOLOTYPE: BM, photograph, NY!).

The variety *patens* is representative of the species as it was originally described. Because of its taxonomic distinctiveness, *A. patens* has long been recognized as a clearly definable species of the eastern United States, although there was some early confusion with *A. undulatus* L., a base-8 species with cordate-petiolate basal leaves and clasping cauline leaves, and there are still many misidentifications involving these two species. The majority of populations making up the var. *patens* are tetraploid and occur east of the Mississippi River. These tetraploids are a versatile group, being capable of reacting favorably to disturbance, and occurring in more kinds of habitats than either *A. phlogifolius* or *A. georgianus*. With their hardiness, long flowering period, and cold-independent achenes, these plants illustrate a generalized adaptation which enables populations of *A. patens* to survive and reproduce under a variety of climatic and edaphic conditions.

3b. *ASTER PATENS* Ait. var. *GRACILIS* Hooker, Companion Bot. Mag. 1: 97. 1835.

Aster patens Ait. (var.) *tenuicaulis* C. Mohr, Pl. Life Alabama, 780. 1901. TYPE: Same type as in *A. patens* Ait. var. *gracilis* Hook.

Aster tenuicaulis (Mohr) Burgess in Small, Fl. SE. U. S., 1903.

Virgulus patens (Ait.) Reveal & Keener var. *gracilis* (Hook.) Reveal & Kenner, Taxon 30: 650. 1981.

Plants differing from the typical variety in the less glandular pubescence, the generally more slender nature of the stems and branches, the cauline leaves usually less than 5 cm long and 2 cm wide, but the differences especially evident in the involucre and floral features. Involucres 4.5–6.5 mm tall, the middle phyllaries 3–4 mm long and 0.7–1.0 mm wide, indument predominantly strigillose, the glandular trichomes usually present but few

and inconspicuous at $30\times$. Heads usually less than 3 cm across the rays. Ray florets with ligules 8–12 mm long. Disc. florets with corollas 4.5–6.5 mm long, the anthers 2.0–2.5 mm long. Mature achenes 2.0–3.0 mm long. $2n=10, 20$, 1–2 B-chromosomes in the diploids. Figure 13.

Distribution (Figure 14). Dry oak-pine and oak-hickory woodlands from western Alabama (Black Belt and western Red Hills) to Texas and Kansas. Late August into November.

TYPE: LOUISIANA. Washington Parish: Jacksonville, 1833, *Drummond* (LECTO-TYPE: here designated K!; ISOLECTOTYPES: GH!, K!, PH!).

Noting that "Mr. Nuttall considers them distinct," Hooker (1835) coined the varietal epithet *gracilis* to describe the slender, long-branched, and small-leaved specimens of *A. patens* collected by Drummond near Jacksonville, Louisiana. Although this varietal name has been used by some authors to refer to slender, long-branched plants in both the Gulf and Atlantic Coastal Plains, the variety *gracilis* is here viewed in the sense of Torrey and Gray (1841) as a southwestern taxon, reaching its eastern limit in western Alabama. This position is taken because there is a demonstrable correlation between the southwestern distribution, involuclral and floral dimensions, involuclral pubescence, and the diploid condition.

The morphological differences between diploids and tetraploids in *A. patens* are primarily quantitative; the best macroscopic indicators of diploidy are slender stems, short involuclres, narrow and prevailingly strigillose phyllaries, and smaller florets. Diploids also average smaller in guard cells ($22 \times 17 \mu\text{m}$) and in pollen grains ($23 \mu\text{m}$) than do tetraploids (27×20 for guard cells and $25 \mu\text{m}$ for pollen). There are, however, no sharp breaks in the variation patterns of any of these features that would allow the reliable prediction of ploidy level from morphology.

3c. *ASTER PATENS* Ait. var. *PATENTISSIMUS* (Lindl.) T. & G., Fl. N. Amer. 2: 115. 1841.

Aster patentissimus Lindl. in DC. Prod. 5: 232. 1836. Basionym.

Aster arnottii Nees ex T. & G., Fl. N. Amer. 2: 115. 1841, *pro. syn.* TYPE: Missouri. St. Louis, *Drummond* (possible ISOTYPES: K!).

Aster continuus Small, Bull. Torrey Bot. Club 25: 620. 1898. TYPE: ARKANSAS. Miller Co.: Texarkana, Aug 1898, *Heller* 4283 (HOLOTYPE: NY!).

Aster subsessilis Burgess in Small, Fl. SE. U. S., 1220. 1903. TYPE: ARKANSAS. Benton Co.: 1899, *Plank* (LECTOTYPE here designated: NY!; ISOELECTOTYPES (3): NY!).

Virgulus patens (Ait.) Reveal & Kenner var. *patentissimus* (Lindl. in DC.) Reveal & Keener, Taxon 30: 650. 1981.

Plants differing from the typical variety only in involuclral features. Involuclre more turbinate, usually over 8 mm tall (up to 12 mm), with phyllaries sometimes conspicuously decurrent on the peduncles, and ranging in number up to 50 or even 60, in 5–7 series, appressed; middle phyllaries



Figure 13. Lectotype of *Aster patens* Ait. var. *gracilis* Hook.

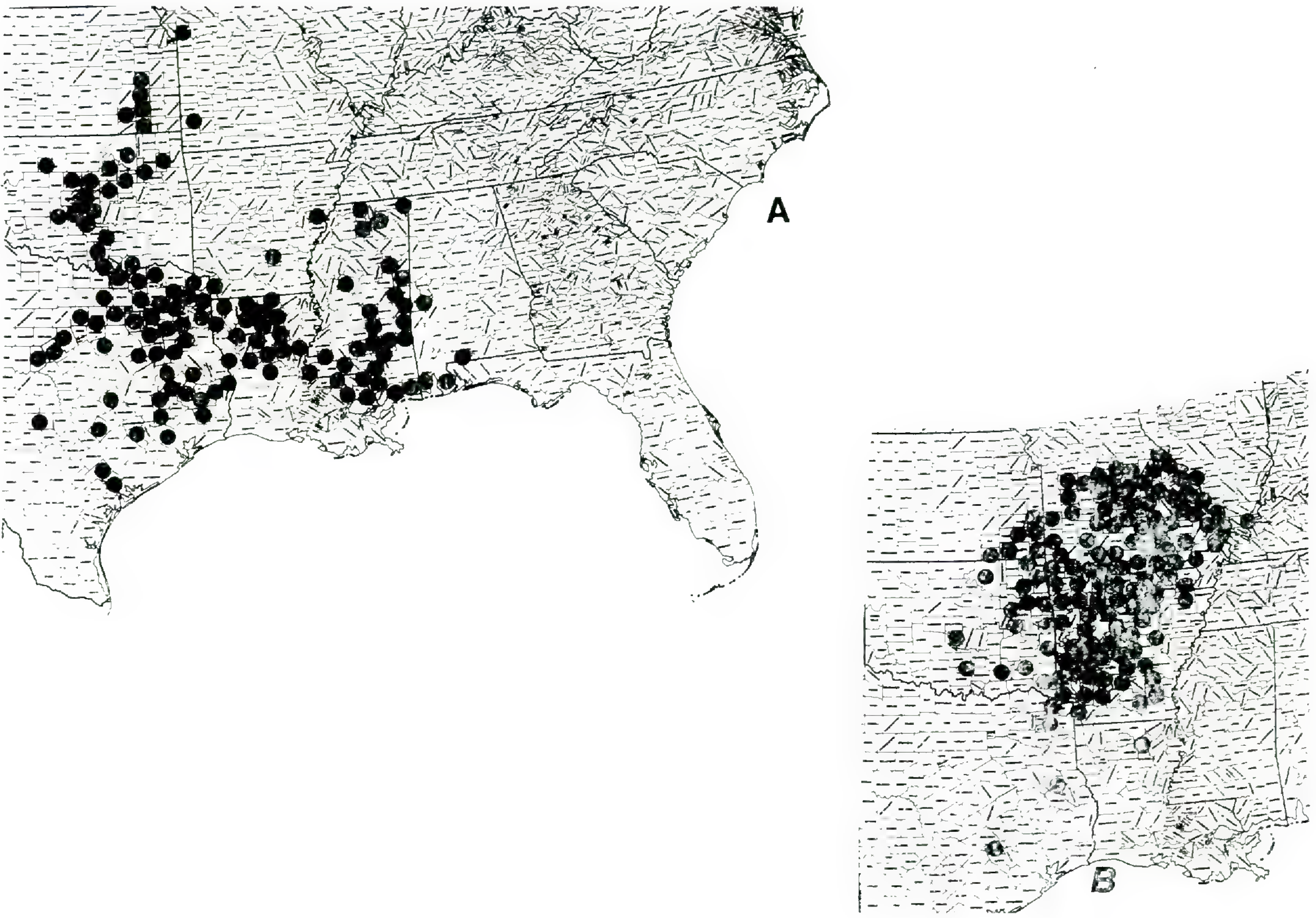


Figure 14. Map A. Distribution of *Aster patens* var. *gracilis*. Map B. Distribution of *Aster patens* var. *patentiissimus*.

broadly linear, 4–6 mm long and 1.2–1.7 mm wide, broadly obtuse, ciliate to fimbriate, the indument predominantly strigillose, often canescent, glandular trichomes sometimes present but few and inconspicuous at $30\times$. $2n=20$, some with 1–4 B-chromosomes. Figure 15.

Distribution (Figure 14). Dry oak-pine and oak-hickory woodlands of the Interior Highlands and adjacent regions. Late August to early November.

TYPE: MISSOURI. St. Louis, 1831, *Drummond* (HOLOTYPE: CGE!).

Originally described as a species, this taxon was reduced to a variety by Torrey and Gray (1841), who noted that the involuclral features “pass insensibly into the ordinary state of the plant.” Although Gray (1884) later rejected the name even as a variety, most later authors have followed the original Torrey and Gray interpretation. Because there is a good relationship between genetically-based involuclral features and geographic range, and also a number of plants with intermediate morphologies, I also treat this taxon at the varietal level.

Populations of *A. patens* var. *patentissimus* are found primarily in the uplands west of the Mississippi River and south of the Missouri River, in habitats similar to those occupied by the var. *patens* in the eastern range of the species. The most extreme forms of var. *patentissimus* occur in the higher elevations of the Ozarkian Plateau and Ouachitan Mountains. Populations of more intermediate morphologies are found throughout the Interior Highlands, but are most common in transitional regions such as southern Illinois, northeastern Texas, and eastern Oklahoma and Kansas.

EXCLUDED TAXA

ASTER FONTINALIS Alexander in Small, Man. Fl. SE. U. S., 1381. 1933 = *Aster patens* Ait. var. *floridanus* Long, Rhodora 72: 40. 1970. This taxon is a plant of southern Florida, possibly a good species, and allied with *Aster dumosus* L.

The sectional affinities of the following taxa need clarification, but they are not obviously allied with *Aster patens* Ait., and I have excluded them from the section *Patentes*: *Aster adnatus* Nutt., *Aster bimater* Standley & Steyermark, *Aster lima* Lindl. in DC., *Aster lucayanus* Britton, *Aster moranensis* H.B.K., and *Aster walteri* Alexander in Small.

ACKNOWLEDGMENTS

This paper is based on my doctoral dissertation deposited at Vanderbilt University, Nashville, Tennessee. I am especially indebted to Dr. Robert Kral for his direction and assistance during the course of the study. I thank Dr. Dean Whittier, Dr. Frederick T. Wolf, Dr. William Clement, and Dr. Giovanni DiSabato for their suggestions and advice. I am also grateful to Dr. R. B. Channell for his encouragement and helpful criticisms. During



Figure 15. Holotype of *Aster patentissimus* Lindl. in DC.

my graduate work I received financial support through teaching and research assistantships from the Department of General Biology.

Significant contributions to this study have been made by the following botanists: Prof. William T. Stearn (BM) and Dr. Alicia Lourteig (P) kindly supplied information on types and gave counsel on other historical matters; and Dr. Arthur Cronquist (NY), Dr. Almut G. Jones (ILL), and Dr. John Semple (WAT) made available to me their ideas and information on the genus *Aster*.

I am grateful to herbarium curators who provided loans of specimens and other documentary materials. The following is a complete list of lending herbaria, identified by their acronyms according to Holmgren and Keuken (1974); ALU, B, BM, CGE, DUKE, F, FSU, GA, GH, IND, K, KANU, KY, LL, MICH, MIN, MO, NCU, NLU, NY, OKL, OS, P, PENN, PH, SMU, TENN, TEX, UARK, UNA, VDB, and WVA.

REFERENCES

- AITON, W. 1789. Hortus Kewensis, Ed. 1. London. Vol. 3.
- ANDERSON, L. C., D. W. KYHOS, T. MOSQUIN, A. M. POWELL and P. H. RAVEN. 1974. Chromosome numbers in Compositae. IX. *Haplopappus* and other Astereae. Amer. J. Bot. 61: 665–671.
- AVERS, C. 1954. In: Documented chromosome numbers of plants. Madrono 12: 210.
- CORRELL, D. S. and M. C. JOHNSTON. 1970. Manual of the vascular plants of Texas. Texas Research Foundation, Renner, Texas.
- CRONQUIST, A. 1947. Notes on the Compositae of the northeastern United States —V. Astereae. Bull. Torrey Bot. Club 74: 142–150.
- . 1977. Notes on the Asteraceae of the southeastern United States. Brittonia 29: 217–225.
- . 1978. Once again, what is a species? In: Biosystematics in agriculture. Beltsville Symposia in Agricultural Research, No. 2: 3–20. Allanheld and Osmond, Monclair, New Jersey.
- . 1980. Vascular flora of the southeastern United States. Vol. 1. Asteraceae. University of North Carolina Press. Chapel Hill, N.C.
- DECANDOLLE, A. 1836. Prodromus systematis naturalis regni vegetabilis . . . Vol. 5. Paris.
- DELISLE, A. L. 1937. The influence of auxin in secondary branching in two species of *Aster*. Amer. J. Bot. 24: 159–167.
- FERNALD, M. L. 1950. Gray's manual of botany. American Book Co., New York.
- GLEASON, H. and A. CRONQUIST. 1963. Manual of vascular plants of northeastern United States and adjacent Canada. D. Van Nostrand Co., Inc., Princeton, New Jersey.
- GRAY, A. 1882. Contributions to North American botany. I. Studies of *Aster* and *Solidago* in the older herbaria. Proc. Amer. Acad. Arts 17: 163–199.
- . 1884. Synoptical flora of North America. Vol. 1. Part 2. Smithsonian Institution, Washington, D. C.
- HARPER, R. 1943. Forests of Alabama. Geological Survey of Alabama. Monograph 10.
- HARRIMAN, N. 1978. In: IOPB chromosome number reports LX. Taxon 27: 223–231.
- HOLMGREN, P. K. and W. KEUKEN. 1975. Index herbariorum. Oosthoek, Scheltema & Holkema, Utrecht, Netherlands.

- HOOKE, W. J. 1835. Notice concerning the late Mr. Drummond's collections, made chiefly in the southern and western parts of the United States. *Companion Bot. Mag.* 1: 95-101.
- HUZIWARA, Y. 1941. On the chromosomes of some species of *Aster* from foreign countries. *Bot. Zool.* 9: 75-76.
- . 1958. Karyotype analysis in some genera of Compositae. V. The chromosomes of American *Aster* species. *Jap. J. Genetics* 33: 129-137.
- JONES, A. G. 1978a. Observations on reproduction and phenology in some perennial asters. *Amer. Midl. Naturalist* 99: 184-197.
- . 1978b. The taxonomy of *Aster* section *Multiflori* (Asteraceae). II. Bio-systematic investigations. *Rhodora* 80: 453-490.
- . 1980a. A classification of the New World species of *Aster* (Asteraceae). *Brittonia* 32: 230-329.
- . 1980b. Data on chromosome numbers in *Aster* (Asteraceae), with comments on the status and relationships of certain North American species. *Brittonia* 32: 240-261.
- JONES, R. L. and A. G. JONES. 1979. In: IOPB chromosome number reports LXIV. *Taxon* 28: 391-408.
- JONES, R. L. 1980. A revision of *Aster* section *Patentes* (Compositae). Ph.D. Thesis, deposited with the Graduate School, Vanderbilt University, Nashville, Tennessee.
- JONES, S.B. 1968. Chromosome numbers in southeastern Compositae. *Bull. Torrey Bot. Club* 95: 393-395.
- KROK, T. 1925. *Bibliotheca botanica suecana*. Almquist & Wiksell Boktryckeri A. B. Uppsala, Stockholm.
- LEDIN, R. B. 1951. The Compositae of South Florida. *Quart. J. Florida Acad. Sci.* 14: 51-207.
- LONG, R. W. 1970. Additions and nomenclatural changes in the flora of southern Florida. *Rhodora* 72: 17-46.
- MOHR, C. 1901. Plant life of Alabama. *Contr. U.S. Natl. Herb.* 6: 1-921.
- NEES VON ESENBECK, C. G. 1832. *Genera et species Asterearum*. Leonard Schrag. Nuremberg.
- NESOM, G. L. 1976. A new species of *Erigeron* (Asteraceae) and its relatives in southwestern Utah. *Brittonia* 28: 263-272.
- . 1978. *Machaeranthera odyseii*, a unique new species from Mexico. *Syst. Bot.* 3: 218-225.
- RADFORD, A. E., H. E. AHLES and C. R. BELL. 1968. *Manual of the vascular flora of the Carolinas*. The University of North Carolina Press, Chapel Hill.
- REVEAL, J. L. and C. S. KEENER. 1981. *Virgulus* Raf. (1837) an earlier name for *Lasallea* Greene (1903) Asteraceae. *Taxon* 30: 648-651.
- SEMPLE, J. 1976. The karyotype of *Aster ericoides* (Asteraceae): some Canadian populations. *Canad. J. Genet. Cytol.* 18: 661-664.
- and L. BROUILLET. 1980a. A synopsis of North American asters: the subgenera, sections, and subsections of *Aster* and *Lasallea*. *Amer. J. Bot.* 67: 1027-1039.
- . 1980b. Chromosome numbers and satellite morphology in *Aster* and *Lasallea*. *Amer. J. Bot.* 67: 1027-1039.
- SMALL, J. K. 1898. Studies in the botany of the southeastern United States. XV. *Bull. Torrey Bot. Club* 25: 605-621.
- . 1903. *Flora of the southeastern United States*. Publ. by the author. New York.
- . 1933. *Manual of the southeastern flora*. Publ. by the author. New York.
- SMITH, E. B. 1965. Chromosome numbers of Kansas flowering plants. II. *Trans. Kansas Acad. Sci.* 68: 463-464.
- STUCKEY, J. and R. JACKSON. 1975. DNA content of seven species of Astereae

- and its significance to theories of chromosome evolution in the tribe. Amer. J. Bot. 62: 509–518.
- SVENSON, H. K. 1935. *Aster patens* Ait. forma *rosea*. Rhodora 37: 263.
- TANNER, H. S. 1844. New universal atlas of the world. Carey & Hart, Philadelphia.
- TORREY, J. and A. GRAY. 1841. Flora of North America. Wiley and Putnam, New York. Vol. 2.
- VAN FAASEN, P. V. and F. F. STRERK. 1973. Chromosome numbers in *Aster*. Rhodora 75: 26–33.
- WILLDENOW, C. L. 1803. Caroli a Linné species plantarum. Ed. 4. G. C. Nauck, Berlin. Vol. 5.

NOTES

LECTOTYPIFICATION OF *VERBESINA TEXANA* BUCKL. (ASTERACEAE): A CORRECTION—In a recent revision of the *Verbesina virginica* (Asteraceae) complex (Olsen, 1979) *V. texana* Buckl. was incorrectly typified. Olsen (1979) selected as a lectotype for this name an 1858 collection by L. C. Ervendberg (#58) from "Wartenberg, near Tantoyuca, prov. Huasteca, (Veracruz), Mexico." Two specimens of this collection, one deposited at the Academy of Natural Sciences of Philadelphia (PH) and the other at the Gray Herbarium (GH), were cited, but neither specimen was specifically designated or marked as the lectotype. Original Buckley material, presumed to be at PH, could not be found when Olsen (1979) published this revision. It was consequently assumed that an 1858 collection by Ervendberg deposited at PH would have been available for Buckley's examination in 1861, the year Buckley visited the herbarium of the Academy of Natural Sciences (Buckley, 1870) and published *V. texana* in the Academy's Proceedings (Buckley, 1861). Such material would be appropriate for a lectotype if it could be established that Buckley in fact examined it. However, there is strong evidence that Buckley did not, because the Ervendberg specimens that are now at PH were part of the Short Herbarium, which was deposited at the Academy in 1864 (Durand, 1864; Pennell, 1936; Mears, 1981). Alternatively, the selection of Ervendberg's collection as a neotype might have been appropriate if the collection agreed with the information given in Buckley's protologue, but it does not. In any case, the designation of the Ervendberg collection as a lectotype must be superseded because original Buckley material has recently been rediscovered at PH.

There is a specimen of *Verbesina texana* in the type herbarium at PH with a label in Buckley's hand (Fig. 1). The label data on the specimen is sparse, e.g., "*Verbesina Texana*/ Buckl./ Northern Texas/ S. B. Buckley," but the label (Fig. 2) is characteristic of those Buckley placed on the specimens he collected in Texas in 1860 and 1861 while employed by the State Geological Survey (Dorr, in prep.). In his protologue Buckley (1861) indicated that *V. texana* was based on material collected in May in "Northern Texas." He also stated that the plants described were collected by him and that specimens were deposited in the herbarium of the Academy of Natural Sciences at Philadelphia and in the herbarium of Elias Durand, which is now in Paris (P-DU). Buckley's specimen of *V. texana* deposited at PH (Fig. 1), because it is part of Buckley's original material and because it conforms to Buckley's (1861) protologue, should serve as the lectotype for *V. texana* Buckl.

In his revision of the *Verbesina virginica* complex Olsen (1959) placed *V. texana* in synonymy under *V. microptera* DC. and distinguished the latter



Fig. 1. Lectotype of *Verbesina texana* Buckl. The label is in Buckley's hand and the annotation in the lower left corner of the specimen is by Durand. The annotation essentially reiterates the comments Gray (1862) published. Fig. 2. Enlargement of the label on the lectotype.

taxon from *V. virginica* L. on the basis of the number of ray and disc florets, geographic range and to a lesser extent floral phenology. The original choice of Mexican material for a lectotype of *V. texana* presented problems in that Buckley was unambiguous in stating that his species was from northern Texas. Olsen (1979) found that *V. virginica* and *V. microptera* (*V. texana*) are separated geographically with *V. microptera* representing the northern Mexico and southern Texas element and *V. virginica* the more northern Texas and southeastern United States element. Based solely on this geographical information one would have to infer that the plant Buckley was describing was *V. virginica* and not *V. microptera*. Information that contradicts this inference is Buckley's mention of May as the flowering date, a date more characteristic of the flowering of *V. microptera*, which flowers from May through November, than that of *V. virginica*, which flowers from August through December (Olsen, 1979). Also, Gray (1862), who examined Buckley's Texas collections and severely criticized Buckley's new species of Texas plants shortly after they were published, wrote that "*Verbesina Texana* is *V. microptera*, DC., a variety of *V. Virginica*."

Verbesina virginica and *V. microptera* are more consistently differentiated on the basis of floral characters than on any other set of characters. *Verbesina virginica* has fewer than 7 ray florets and fewer than 15 disc florets per head whereas *V. microptera* has more than 9 ray florets and more than 20 disc florets per head (Olsen, 1979). Although the heads on the specimen we have selected as lectotype for *V. texana* are immature it is apparent that each head has more than 9 ray florets and more than 20 disc florets (Buckley's original description did not include an adequate description of the flowers). This information, coupled with Buckley's (1861) note on flowering time and Gray's (1862) published comments, supports Olsen's (1979) decision to place *V. texana* in synonymy under *V. microptera*, but it makes Buckley's (1861) account of the type locality problematic. The discrepancy can be explained if Buckley mislabelled some of his 1860 and 1861 collections. In May 1861 Buckley collected plants in northern Texas, but in May 1860 he collected in the vicinity of Corpus Christi, Texas (Buckley, 1874). The latter locality is within the range of *V. microptera*. Elsewhere there is ample evidence of the haste and carelessness with which Buckley assembled his papers describing his 1859, 1860 and 1861 collections (Gray, 1862; Buckley, 1870) and this carelessness may have applied to his collecting and labelling activities as well. In light of the evidence we have assembled it seems likely that Buckley mislabelled the locality on his specimen of *V. texana*.

In summary, the lectotype we choose to supersede the original choice of lectotype (Olsen, 1979) is as follows:

VERBESINA TEXANA Buckl., Proc. Acad. Nat. Sci. Philadelphia 13: 458. 1861 (1862). LECTOTYPE: UNITED STATES. TEXAS: "Northern Texas," S. B. Buckley *s.n.* (PH!).

We also consider the name to be a synonym of *Verbesina microptera* DC.

We thank the curators of PH and GH for the loan of specimens. Research on Buckley was supported by a grant to L. J. D. from the McHenry Fund of the Academy of Natural Sciences of Philadelphia.—*Laurence J. Dorr, Department of Botany, University of Texas, Austin, TX 78712 and John Olsen, Department of Biology, Southwestern at Memphis, Memphis, TN 38112.*

REFERENCES

- BUCKLEY, S. B. 1861 (1862). Description of new plants from Texas. Proc. Acad. Nat. Sci. Philadelphia 13: 448–463.
- . 1870. Remarks on Dr. Gray's notes on Buckley's new plants of Texas. Proc. Acad. Nat. Sci. Philadelphia 22: 135–138.
- . 1874. First annual report of the Geological and Agricultural Survey of Texas. A. C. Gray, Houston.
- DURAND, E. 1864. Report of the Botanical Committee, for 1864. Proc. Acad. Nat. Sci. Philadelphia 16: 291–292.
- GRAY, A. 1862. Notes upon the "Description of New Plants from Texas, by S. B. Buckley," published in the Proceedings of the Academy of Natural Sciences of Philadelphia, Dec. 1861 and Jan. 1862. Proc. Acad. Nat. Sci. Philadelphia 14: 161–168.
- MEARS, J. A. 1981. Guide to plant collectors represented in the herbarium of the Academy of Natural Sciences of Philadelphia. Proc. Acad. Nat. Sci. Philadelphia 133: 141–165.
- OLSEN, J. 1979. Taxonomy of the *Verbesina virginica* complex (Asteraceae). Sida 8: 128–134.
- PENNELL, F. W. 1936. Elias Durand and his association with the Academy of Natural Sciences of Philadelphia. Bartoniana 17: 33–39.

NEWLY ADVENTIVE GRASSES IN THE FLORA OF TRINIDAD.—

In the course of working through my recent collections of vascular plants from Trinidad, I encountered two weedy grass species not heretofore credited to the island.

ERAGROSTIS UNIOLOIDES (Retzius) Nees ex Steudel (Poaceae: Festuceae) is an annual, weedy grass of general distribution in Tropical Asia and Africa. There is little in the literature as to its occurrence in the New World. Small (1933) and Hitchcock and Chase (1950) report it for Georgia and Florida; it is listed for Georgia in Duncan and Kartesz (1981); and David Hall (FLAS; pers. comm.) informs me the species has been repeatedly collected in Florida from Polk County north. Koch (1978) makes no mention of it. It may now be recorded as an adventive in the neotropics: Trinidad, Aripo Savannah, roadside waste area, 18 Jan 1982, *Harriman* 17667; Ruiz Trace off Heights-of-Aripo Road beyond mi 4, 21 Jan 1982, *Harriman* 17635;

Mora Forest Preserve, 4-5 3/4 mi E of Sangre Grande, 23 Jan 1982, *Harriman* 17716. All vouchers are in OSH with duplicates to be distributed. In Hitchcock (1936), still the only treatment that covers the grasses of Trinidad, the species will with difficulty key to *E. Berteroniana* (Schult.) Steud., a species with narrower spikelets and narrowly involute leaves, known only from Hispaniola. *Eragrostis unioides* is amply described and very nicely illustrated in Hsu (1975; 1978).

ISCHAEMUM INDICUM (Houtt.) Merrill, Poaceae: Andropogoneae) is a weedy grass of general distribution in India and southeast Asia (Bor, 1960; Hsu, 1978). Croat (1978) gives its range in the New World as Mexico to Ecuador and Brazil and the West Indies. Pohl (1980) credits it only to Costa Rica, Panama, and Guyana. The species is not mentioned in Hitchcock (1936), nor in Gould (1979), nor in Adams (1972). I can confirm its occurrence in Panama (Canal Zone: lawn weed at the Riesch residence in Diablo Heights, 10 Apr 1976, *Nelson* 146, OSH), and add a Trinidad locality (Blanchisseuse Road at mi 10, at a microwave relay station, 16 Jan 1982, *Harriman* 17516, OSH). The grass was so abundant along a goat-grazed roadside as to suggest it had been deliberately planted. The West Indian species of *Ischaemum*, now three in number, all occur in Costa Rica as well, and the key in Pohl (1980) will serve very adequately to distinguish them. His elegant descriptions will likewise facilitate naming material; I would add only that my Trinidad collection of *I. indicum* has the first glume of the sessile spikelet only scaberulous, not pilose, a variation well within the limits of the species as it is circumscribed in Bor (1960).—Neil A. Harriman, Biology Department, University of Wisconsin-Oshkosh, Oshkosh, WI 54901.

REFERENCES

- ADAMS, C. D. 1972. Flowering plants of Jamaica. University of the West Indies, Mona. 848 pp.
- BOR, N. L. 1960. The grasses of Burma, Ceylon, India and Pakistan. Pergamon Press, Oxford. 767 pp.
- CROAT, T. B. 1978. Flora of Barro Colorado Island. Stanford University Press, Stanford. 943 pp.
- DUNCAN, W. H. and J. T. KARTESZ. 1981. Vascular flora of Georgia. An annotated checklist. University of Georgia Press, Athens. 147 pp.
- GOULD, F. W. 1979. Poaceae. In R. A. Howard, Flora of the Lesser Antilles 3: 25–220. Arnold Arboretum, Harvard University, Jamaica Plain.
- HITCHCOCK, A. S. 1936. Manual of the grasses of the West Indies. U.S.D.A. Misc. Publ. No. 243. 439 pp.
- and A. Chase. 1950. Manual of the grasses of the United States. U.S.D.A. Misc. Publ. No. 200. 1051 pp.
- HSU, CHIEN-CHANG. 1975. Taiwan Grasses. Taiwan Provincial Education Association, Taipei. 884 pp.

- _____. 1978. Gramineae. In H. Li et al., Flora of Taiwan 5: 372–783. Epoch Publishing Co., Taipei.
- KOCH, S. D. 1978. Notes on the genus *Eragrostis* (Gramineae) in the southeastern United States. *Rhodora* 80: 390–403.
- POHL, R. W. 1980. Family #15, Gramineae. In W. Burger, Flora Costaricensis. Fieldiana, Bot., New Ser. No. 4. 608 pp.
- SMALL, J. H. 1933. Manual of the southeastern flora. University of North Carolina Press, Chapel Hill. 1554 pp.

REDISCOVERY OF *HYMENOXYS TEXANA* AND NOTES ON TWO OTHER TEXAS ENDEMICS—Three endemic species were described prior to 1900 from low prairies near Houston, Texas. The specimens were collected by Charles Wright in the 1840's, Elihu Hall in 1872, and Houston's own resident botanist, F. W. Thurow, in 1889-90 and 1897 (actually resided in Hockley during that period).

Charles Wright taught at Rutgersville College (near La Grange, Texas) in 1845 and 1846. The college and town of Rutgersville no longer exist. Evidently, Wright traveled and collected along the road from near La Grange to Houston. He had previously visited Columbus, Texas in 1844 where he had relatives. According to Geiser (1937), Wright returned to Cambridge and spent the winter of 1848–49 helping Asa Gray sort out Wright's Texas collections. In 1849, Gray described one of Wright's collections as *Aplopappus aureus* Gray (Pl. Fendl., Mem. Amer. Acad. N.S. 4: 76, *Wright s.n.*, GH), the species now known as *Machaeranthera aurea* (Gray) Shinnars, (Field & Lab. 18: 41. 1950).

F. W. Thurow lived in Hockley and collected plants in the 1880's and 1890's. He came from the Black Forest area in Germany when he was 12 years old and lived in Hockley for 43 years. His last 8 years were spent in Houston (Vines & Thurow, 1964). He collected *Machaeranthera aurea* in 1897 near Hockley (Fig. 1). He also collected *Hymenoxys texana* (Coulter & Rose) Cockerell in 1889-1890, a new species that was described by Coulter & Rose in 1891 (as *Actinella texana*; Bot. Gaz. 16: 27; *Thurow s.n.*, Palmer 742; Fig 2). Of it, Correll & Johnston (1970) state "Rare in sandy soils near Hockley and Houston, Harris Co., probably extinct (no known collections after 1900), Mar-Sep; endemic."

In 1872, Elihu Hall collected 861 specimens of plants in east Texas (Geiser, 1937). In his publication "Plantae Texanae" in 1873, he listed *Thalictrum debile* Buckl. var. *texana* Gray without a description (Fig. 3). Since this name is apparently a nomen nudum, the author citation refers to Gray's treatment in the Synoptical Flora of North America (Robinson, Editor, Volume 1, pt. 1, fasc. 1, p. 18. 1895) where Hall's publication, specimen (as occurring in moist prairies about Houston), and name as a variety are cited. Small (1903) elevated the taxon to the rank of species.



Fig. 1. *Machaeranthera aurea*: a. habit; b. leaves; c. disc flower; d. ray flower; e. head, top view. By permission: Mahler, 1981.

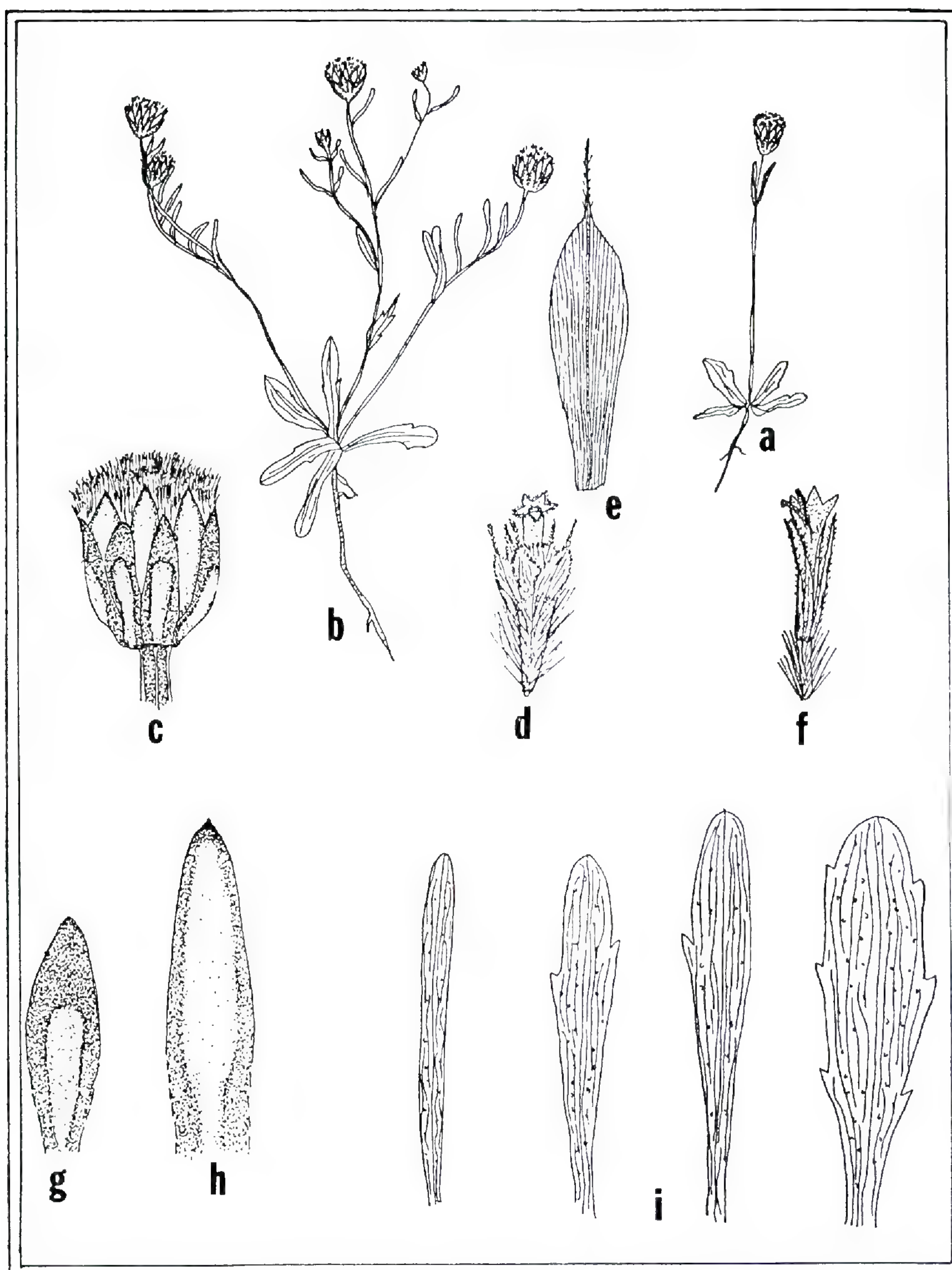


Fig. 2. *Hymenoxys texana*: a,b. habit; c. head; d. disc flower; e. pappus scale; f. ray flower, g. outer phyllary; h. inner phyllary; i. leaves, left to right, upper to lower respectively.

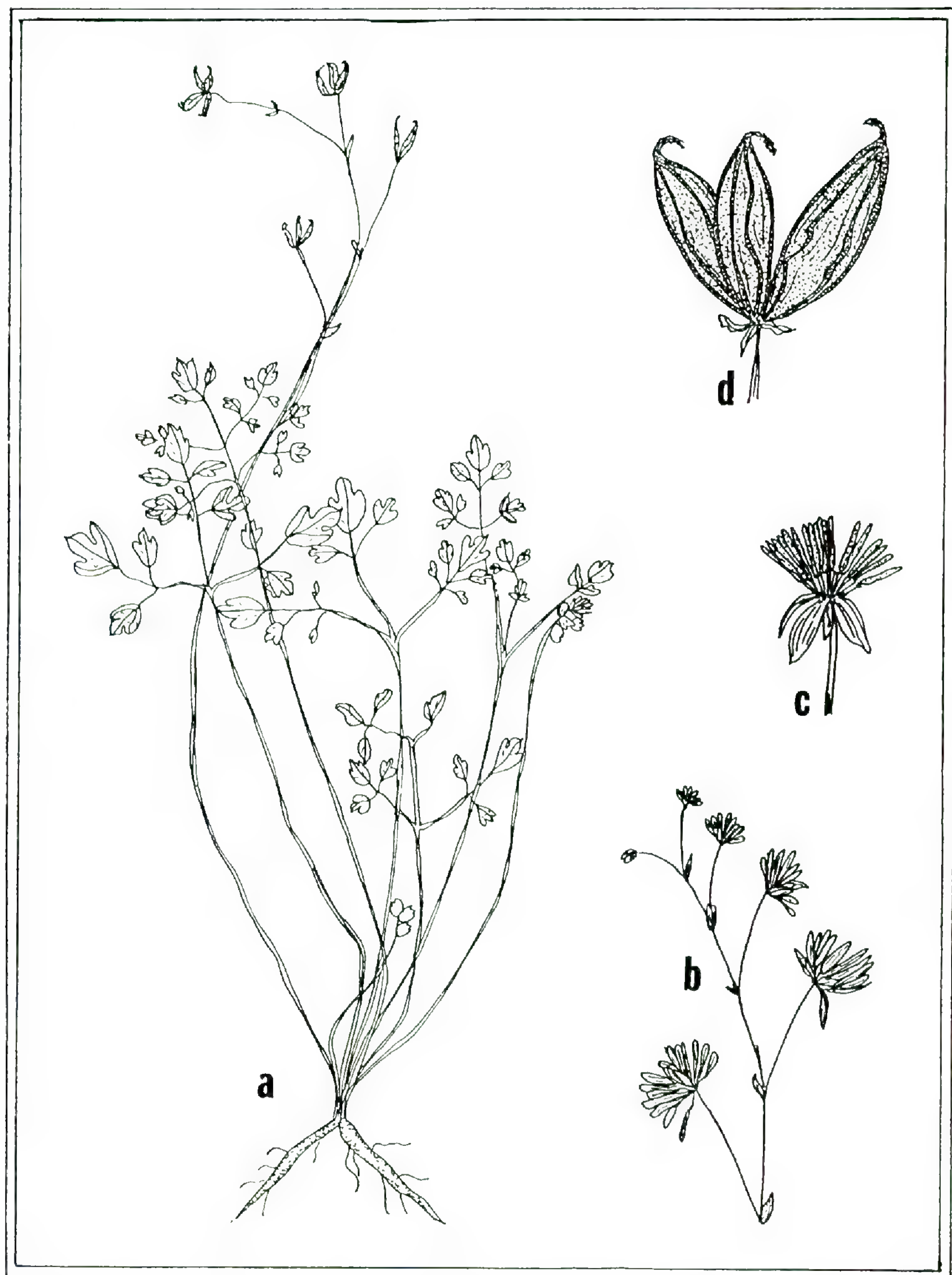


Fig. 3. *Thalictrum texanum*: a. habit, fruiting; b. pistillate flowers; c. staminate flower; d. fruits.

Financial support from the Office of Endangered Species, U.S. Fish and Wildlife Service, Albuquerque NM enabled me to conduct field studies to determine if current populations still existed. I rediscovered *Machaeranthera aurea* in the vicinity of Cypress in the fall of 1980 (Mahler, 1981). Since that publication, another herbarium specimen was found by James W. Kessler (Texas A&M University) from Galveston County (TAES). With the habitat of this taxon noted, I enlisted the aid of Kessler who began searching the same area the following spring (March 1981) for *Hymenoxys texana*. He rediscovered three small populations growing in the equivalent of "buffalo wallows" or shallow wet depressions, the first collection since Thurow's in 1889-90.

In the original article, it was stated that *Actinella texana* was "also mounted on a sheet with *A. odorata* (No. 742) of Palmer's 1879-80 collection from S.W. Texas." Examination of a duplicate of *Palmer 742* at US by R. B. Faden (1981, pers. comm.) revealed no specimen of *A. texana* mounted on it, but the label did provide more precise data: Jan 1880, between the Nueces and the Frio rivers on the Old San Antonio Road. Toney M. Keeney (Southwest Texas Junior College) and I have searched unsuccessfully in this area.

Additional data are being sought regarding the current distribution of *Thalictrum texanum* (Gray) Small. The only specimens I have examined were from Brazos County: moist post oak woodland, 13 mi S of College Station near Highway 6, 15 Mar 1970, *Lonard & Bacon 2533* (SAT, SMU); frequent in moist woods along creek, 9.6 mi SE of College Station, 26 Mar 1949, *Cory 55203* (SMU); shady, sandy soil, 8 mi SE of College Station, 11 Mar 1949, *Whizenhunt 19* (TAMU); growing in damp sandy soil partially shaded area 6 mi S of College Station in road ditch along Highway 6, 20 Mar 1957, *Cypert 106* (TAMU). The small stature, 30 cm or less tall, renders this species rather distinct as well as probably inconspicuous.

In summary, three rare endemic species were described in the 1800's with their type localities all from the prairies near Houston, Texas. Populations of two of the three endemics are now known, with current populations of *Thalictrum texanum* still being sought.—*Wm. F. Mahler, Herbarium, Southern Methodist University, Dallas, TX 75275.*

REFERENCES

- CORRELL, D. S. and M. C. JOHNSTON. 1970. Manual of the vascular plants of Texas. Texas Research Foundation, Renner, Texas. p. 1678.
 GEISER, S. W. 1937. Naturalists of the frontier. SMU Press, Dallas, Texas. pp. 232-236.
 MAHLER, W. F. 1981. Notes on rare Texas and Oklahoma plants. *Sida* 9: 76-86.
 SMALL, J. K. 1903. Manual of the southeastern flora. Publ. by author, New York. pp. 446, 1331.

VINES, R. A. and F. W. THUROW. 1964. A checklist of the native and naturalized plants of Houston and vicinity. Publ. by author, Houston. pp. 90, 97.

RANGE EXTENSIONS FOR CYPERACEAE IN LOUISIANA AND TEXAS—*CYPERUS DISTINCTUS* Steud., a perennial with short, thick rhizomes, inhabits wet sandy areas near lakes, streams, and ditches or depressions in pine savannas and flatwoods. It is often confused with *C. pseudovegetus* Steud. and *C. virens* Michx., but can be easily distinguished from them by the presence of a basal callosity on the achene. It has been previously reported from Charleston Co., South Carolina south to southern Florida and west to about the Apalachicola River in the Florida Panhandle (Radford, Ahles, and Bell, 1968; Godfrey and Wooten, 1979). A specimen of *C. distinctus*, new to Louisiana, was collected in St. Charles Parish: Bonnet Carre Spillway, center of floodway just N of river road, infrequent in low wet areas, 18 Oct 1973, *Montz 2904* (NO).

CYPERUS TENUIS Sw. has been previously reported in Texas from Cameron, Duval, Karnes, Nueces, and San Patricio counties (Correll and Johnston, 1970). Numerous specimens of *C. tenuis* were found along a two mile area of Cypress Creek in northeast Harris Co., *Kessler 2030* (SMU, TAES). Additional collections were discovered from Brazoria Co., *Fleetwood 10202* (SMU) and Dewitt Co., *Correll 17511* (TEX). This extends the known range of *C. tenuis* about 200 miles northeast. This species may have been accidentally dispersed in Harris County by the Mercer family in the 1940's or 1950's when they brought numerous plants from south Texas.

PSILOCARYA SCIRPOIDES Torr. was recently reported new to Louisiana from Washington Parish by Allen and Vincent (1982). Since this report, two additional specimens have been examined: Winn Parish, *Kessler 582* (NLU) and Washington Parish, *Thomas 46160* (NLU). *James W. Kessler, Tracy Herbarium, Dept. of Range Science, Texas A&M University, College Station, TX 77843.*

REFERENCES

- ALLEN, C. M. and K. A. VINCENT. 1982. *Psilocarya scirpoides* Torr. (Cyperaceae) and *Physalis missouriensis* Mackenz. & Bush (Solanaceae) new to Louisiana. *Sida* 9(4): 367-368.
- CORRELL, D. S. and M. C. JOHNSTON. 1970. Manual of the vascular plants of Texas. Texas Research Foundation, Renner.
- GODFREY, R. K. and J. W. WOOTEN. 1979. Aquatic and wetland plants of southeastern United States, Monocotyledons. The University of Georgia Press, Athens.
- RADFORD, A. E., H. E. AHLES and C. R. BELL. 1968. Manual of the vascular flora of the Carolinas. The University of North Carolina Press, Chapel Hill.

REVIEW

THE GRASSES OF BAJA CALIFORNIA, MEXICO. Gould, Frank W. and Reid Moran. San Diego Society of Natural History Memoir 12. 140 pp. 1981. San Diego Museum of Natural History, Box 1390, San Diego, CA 92112. \$14.00

SIDA 10(1): 92. 1983.

This manual of the grasses of Baja California includes a brief introduction to the political and geographic aspects, the history of the agrostology of the area, and keys, descriptions, and notes on the native and introduced taxa.

The Introduction consists of six pages of text plus one map of the region. Three phytogeographic regions are discussed: the northwest or Californian region, the Cape region, and the desert along with a map of Lower California. An analysis of the grass flora is given in respect to past authors comments and in this treatment, 96 genera and 274 species of native and introduced grasses are treated. They tentatively regard seven species and one variety as endemic to Baja California. Another aspect of the introduction deals with the principal collectors who have added records of grasses and another section treats the earlier accounts of the grasses. A pictorial review of grass terminology is presented in three figures.

The classification outline also includes the number of species described in the systematic treatment. The keys are similar to those in other Gould publications but adapted for the taxa of Baja California. Descriptions and notes account for the systematic treatment along with illustrations representing most of the genera.

Since this is the most comprehensive treatment of the grasses of Baja California, this manual is a valuable tool for the identification of grasses of this region as well as a reference guide.—*Wm. F. Mahler, Herbarium, Southern Methodist University, Dallas, TX 75275.*

SIDA CONTRIBUTIONS TO BOTANY

VOLUME 10

NUMBER 2

NOVEMBER 1983

CONTENTS

Very personal generic names (<i>nomina perpropria</i>): a contribution to whimsical botany. <i>Paul A. Fryxell</i> .	95
Trichomes and stomata of <i>Gordonia lasianthus</i> (Theaceae). <i>Loran C. Anderson</i> .	103
Vascular flora of Kentucky: additions and other noteworthy collections. <i>Max E. Medley, Ray Cranfill and John W. Thieret</i> .	114
A comparison of <i>Poa tracyi</i> and <i>Poa occidentalis</i> (Poaceae: Poeae). <i>Robert J. Soreng and Stephan L. Hatch</i> .	123
The <i>Desmodium paniculatum</i> (L.) DC. (Fabaceae) complex revisited. <i>Duane Isely</i> .	142
Taxonomy of <i>Erigeron concinnus</i> (Asteraceae) and its separation from <i>E. pumilus</i> . <i>Guy L. Nesom</i> .	159
Rediscovery of <i>Lesquerella pallida</i> (Cruciferae). <i>Elray S. Nixon, John R. Ward and Barney L. Lipscomb</i> .	167
New species, new combinations and notes on the goldenrods (<i>Euthamia</i> and <i>Solidago</i> —Asteraceae). <i>Constance E. S. Taylor and R. John Taylor</i> .	176
<i>Stipa curvifolia</i> (Poaceae)—Studies on a rare taxon. <i>Stephan L. Hatch and David A. Bearden</i> .	184
NOTES. Two additions to the Arkansas flora from Warren Prairie. 188— <i>Cypripedium candidum</i> Muhl. ex Willd. (Orchidaceae) in Arkansas. 189— <i>Murdannia keisak</i> (Hassk.) Hand.-Mazz. (Commelinaceae), <i>Bothriochloa hybrida</i> (Gould) Gould (Poaceae), and <i>Scutellaria racemosa</i> Pers. (Lamiaceae) new to Louisiana. 189—Cyperaceae new to Texas and Louisiana. 190— <i>Panicum sphaerocarpon</i> Ell. var. <i>polyanthes</i> (Schultes) A. S. Sherif (Poaceae) comb. nov. 191—The role of plant succession in the extinction of plant species. 191.	
CORRECTION	192
REVIEW	192
IN MEMORIAM	192
REVIEWERS	193

US ISSN 0036-1488

SIDA, CONTRIBUTIONS TO BOTANY

Founded by Lloyd H. Shinnars, 1962

Publisher

Wm. F. Mahler
SMU Herbarium
Dallas, Texas, 75275

Associate Editor

John W. Thieret
Northern Kentucky University
Highland Heights, Kentucky, 41076

Editor

Barney L. Lipscomb
SMU Herbarium
Dallas, Texas, 75275

Guidelines for contributors are available upon request.

Subscription: \$10.00 (U.S.) per year; numbers issued twice a year.

©

Sida, Contributions to Botany, Volume 10, Number 2, pages 95–193.

Copyright 1983

by Wm. F. Mahler

VERY PERSONAL GENERIC NAMES (*NOMINA PERPROPRIA*): A CONTRIBUTION TO WHIMSICAL BOTANY

PAUL A. FRYXELL

U.S. Department of Agriculture, ARS, College Station, TX 77841

Botanists familiar with the writings of Linnaeus (1938) or Stearn (1966) and with the Nomenclatural Code (Stafleu et al., 1978) know that generic names may be formed in a variety of ways. They may commemorate persons or places, may be descriptive (provided they are not technical morphological terms), may be anagrams, or "may even be composed in an absolutely arbitrary manner" (ICBN, Article 20). Thus, there is ample scope for botanists to use their imaginations in devising new generic names.

Botanists frequently form a generic name in commemoration of a man or a woman, often a notable botanist or plant collector, sometimes a botanical illustrator or a patron of botany, and occasionally a person whose connection with botany is tenuous or unclear, although the Code (Recommendation 20A, h) recommends against the latter course. Such dedicatory names are most commonly formed by adding to the person's surname a grammatically appropriate ending (e.g. *Turnera*, *Linnaea*). Sometimes a single botanist is commemorated more than once by different authors, who combine various prefixes and suffixes with the surname (e.g. *Brittonia*, *Brittonella*, *Brittonastrum*, *Neobrittonia*). Additional names may be formed by combining the person's surname with the root of a generic name (e.g. *Merrilliopanax*, *Lauromerrillia*) or more commonly with a descriptive term (*Mortonia*, *Mortoni dendron*).

Here I am concerned with dedicatory generic names that are formed by combining a person's given name and surname thereby *more specifically* honoring the particular individual than if only his or her surname were used. For example, some might know or be able to surmise who is honored by the name *Johnstonella* Brandegee but many of us would have to do some library research to find out. On the other hand, the honorees of the names *Ivanjohnstonia* Kazmi and *Marshalljohnstonia* Henrickson are evident. They specifically honor a given person with a "very personal" generic name.

I became interested in this byway after recently publishing the generic name *Billieturnera* for a distinctive genus of Malvaceae, honoring a distinctive botanist. Some of my colleagues commented good-naturedly (I trust) on my publishing such a polysyllabic name. Because the Code (Recommendation 20A, c) recommends against making names "that are very long or difficult to pronounce in Latin," I investigated the history of such *nomina*

perpropria and present a list of them. It is not exhaustive, since there undoubtedly are names I have overlooked, and there certainly are some *nomina perpropria* that are more or less cryptic in their derivation (as will be discussed later) and are not easily recognized as such. (In the following list, asterisks indicate individuals who are still living.)

ABDULMAJIDIA Whitm., Kew Bull. 29: 207. 1974. LECYTHIDACEAE, honoring Tuan Haji Abdul Majid bin Haji Mohammed Shahid, forester.

ACSMITHIA Hoogl., (cited by Airy Shaw, 1966, but I cannot discover that it has been otherwise published). CUNONIACEAE, honoring Albert Charles Smith, 1906-*, botanist.

ALBERTOKUNTZEA Kuntze, Revis. Gen. Pl. 2: 550. 1891. PHYTOLACACEAE, honoring Albert Kuntze, Jr., banker.

ALEXGEORGIA Carlq., Austral. J. Bot. 24: 282. 1976. RESTIONACEAE, honoring Alex S. George, botanist.

ALLANBLACKIA Oliver in Bentham & Hooker, Gen. Pl. 1: 980. 1867. GUTTIFERAE, honoring Allan A. Black, 1832–1965.

ALLENROLFEA Kuntze, Revis. Gen. Pl. 2: 545. 1891. CHENOPODIACEAE, honoring Robert Allen Rolfe, 1855–1921, botanist.

AMOLINIA King & Robinson, Phytologia 24: 265. 1972. COMPOSITAE, presumably honoring Antonio Molina, 1926-*, botanist.

ARNOLDOSCHULTZEA Mildbr., Wiss. Erg. Deut. Zentr.-Afr. Exped. Bot. 1910–11, 2: 61. 1922. SAPOTACEAE, honoring Arnold Schultze, plant collector.

BARKERWEBBIA Becc. in Martelli, Webbia 1: 281. 1905. PALMAE, honoring Philip Barker Webb, 1793–1854, botanist.

BILLIETURNERA Fryx. Sida 9: 195. 1982. MALVACEAE, honoring Billie Lee Turner, 1925-*, botanist.

BURTTDAVYA Hoyle in Hooker, Icon. Pl. 34: *t.* 3318. 1936. RUBIACEAE, honoring Joseph Burtt Davy, 1870–1940, botanist.

CAPTAINCOOKIA Hallé, Adansonia 13: 197. 1973. RUBIACEAE, honoring *Capt.* James Cook, 1728–1779, explorer.

CARLOMOHRIA E. Greene, Erythea 1: 246. 1893. STYRACACEAE, honoring Charles Theodore Mohr, 1824–1901, botanist.

CARLOSTEPHANIA Bubani, Fl. Pyren. 2: 658. 1900. ONAGRACEAE, honoring Charles Estienne (latinized to Carlos Stephanus), 1504–1564, physician.

CARLOWRIGHTIA A. Gray, Proc. Amer. Acad. Arts 13: 364. 1878. ACANTHACEAE, honoring Charles Wright, 1811–1885, plant collector.

CARLOFRITSCHIA Engler, Bot. Jahrb. Syst. 26: 362. 1899. GESNERIACEAE, honoring Karl F. Fritsch, 1864–1934, botanist.

CAROLI-GMELINA P. Gaertner et al., Oekon. Fl. Wetterav. 2: 419. 1800. CRUCIFERAE, honoring Carl Christian Gmelin, 1762–1837, botanist.

CECARRIA Barlow, Brittonia 25: 34. 1973. LORANTHACEAE, honoring Cedric Erroll Carr, 1892–1936, plant collector.

- CYRILWHITEA Ising, Trans. Roy. Soc. S. Austral. 88: 61. 1964. CHENOPODIACEAE, honoring Cyril Tenison White, 1890–1950, botanist.
- DONNELLSMITHIA Coulter & Rose ex Coulter, Bot. Gaz. 15: 15. 1890. UMBELLIFERAE, honoring John Donnell Smith, 1829–1928, botanist.
- EDBAKERIA Viguier, Notul. Syst. 13: 364. 1949. LEGUMINOSAE, presumably honoring Edmund Gilbert Baker, 1864–1949, botanist.
- EDITHCOLEA N. E. Br., Kew Bull. 1895: 220. 1895. ASCLEPIADACEAE, honoring Edith Cole, plant collector.
- EDUARDOREGELIA Popov, Ind. Sem. Hort. Bot. Almaat. Acad. Sci. no. 3. 1936; ex Buxbaum, Bot. Archiv 38: 389. 1937. LILIACEAE, honoring Eduard August von Regel, 1815–1892, botanist.
- ELIDURANDIA Buckley, Proc. Amer. Acad. Sci. Philad. 1861: 450. 1862. MALVACEAE, honoring Elias Magloire Durand, 1794–1873, botanist.
- ELMERRILLIA Dandy, Kew Bull. 1927: 261. 1927. MAGNOLIACEAE, honoring Elmer Drew Merrill, 1876–1956, botanist.
- ENRIQUEBELTRANIA Rzed., Bol. Soc. Bot. Méx. 38: 75. 1979. EUPHORBIACEAE, honoring Enrique Beltrán, 1903-*, botanist.
- ERNESTIMEYERA Kuntze in Post & Kuntze, Lexic. Gen. Phan. 205. 1903. RUBIACEAE, honoring Ernst Heinrich Friedrich Meyer, 1791–1858.
- HARLANLEWISIA Epling, Amer. J. Bot. 42: 436. 1955. LABIATAE, honoring Frank Harlan Lewis, 1919-*, botanist.
- HARRYSMITHIA H. Wolff, Acta Horti Gothob. 2: 310. 1926. UMBELLIFERAE, presumably honoring Karl August Harold ("Harry") Smith, 1889-?
- HELIABRAVOA Backeb., Cact. Succ. J. Gr. Brit. 18: 23. 1956. CACTACEAE, honoring Helia Bravo Hollis, 1903-*, botanist.
- HENRIBAILLONIA Kuntze, Revis. Gen. Pl. 2: 606. 1891. EUPHORBIACEAE, honoring Henri Baillon, 1827–1895, botanist.
- IFDREGIA Steudel, Nomencl. Bot. ed. ii. 1: 801. 1840. UMBELLIFERAE, honoring Johann Franz Drège, 1794–1881, plant collector.
- IRVINGBAILEYA Howard, Brittonia 5: 50. 1943. ICACINACEAE, honoring Irving Widmer Bailey, 1884–1967, botanist.
- ISIDROGALVIA Ruiz & Pavón, Fl. Peru 3: 69. *t.* 302. 1802. LILIACEAE, honoring Isidorus Galvéz, illustrator.
- IVANJOHNSTONIA Kazmi, Sultania 1: 1. 1975. BORAGINACEAE, honoring Ivan Murray Johnston, 1898–1960, botanist.
- JACQUESHUBERIA Ducke, Arch. Jard. Bot. Rio de Janeiro 3: 118. 1922. LEGUMINOSAE, honoring Jacques E. Huber, 1867–1914.
- JAMESBRITTENIA Kuntze, Revis. Gen. Pl. 2: 461. 1891. SCROPHULARIACEAE, honoring James Britten, 1846–1924, botanist.
- JARANDERSONIA Kosterm., Reinwardtia 5: 319. 1960. TILIACEAE, honoring J. A. R. Anderson, forester.
- JOANNEGRIA Chiov., Ann. Bot. (Rome) 11: 231. 1913. GRAMINEAE, honoring Giovanni Negri, 1877–1960.

- JOHANNESTEIJSMANNIA H. Moore, *Principes* 5: 116. 1961. PALMAE, honoring Johannes Elias Teysmann, 1809–1882, botanist.
- JUTTADINTERIA Schwantes, *Z. Sukkulentenk.* 2: 182. 1926. MORACEAE, honoring Helena Jutta Dinter, wife of Moritz Kurt Dinter, botanist.
- KINGDON-WARDIA Marquand, *J. Linn. Soc., Bot.* 48: 207. 1929. GENTIANACEAE, honoring Francis Kingdon Ward, 1885–1958, plant collector.
- LENBRASSIA Gillett, *J. Arnold Arbor.* 55: 431. 1974. GESNERIACEAE, honoring Leonard John Brass, 1900–?, plant collector.
- MARSHALLFIELDIA Macbride, *Publ. Field Mus. Nat. Hist., Bot. Ser.* 4: 175. 1929. MELASTOMATACEAE, honoring *Capt.* Marshall Field (Marshall Field III), 1893–1956, merchant and philanthropist.
- MARSHALLJOHNSTONIA Henrickson, *Syst. Bot.* 1: 169. 1976. COMPOSITAE, honoring Marshall Conring Johnston, 1930–*, botanist.
- MAXBURRETIA Furtado, *Gard. Bull. Straits Settlem.* 11: 240. 1941. PALMAE, honoring Carl Ewald Maximilian Burret, 1883–1964.
- NEBROWNIA Kuntze, *Revis. Gen. Pl.* 2: 742. 1891. ARACEAE, honoring Nicholas Edward Brown, 1849–1934, botanist.
- NORMANBOKEA Kladiwa & F. Buxb. in Krainz, *Kakteen*, lief. 40–41, *Gen.* 108b. 1969. CACTACEAE, honoring Norman Hill Boke, 1913–*, botanist.
- OAKES-AMESIA Schweinfurth & Allen, *Bot. Mus. Leaf.* 13: 133. 1948. ORCHIDACEAE, honoring Oakes Ames, 1874–1950, botanist.
- OTTOSCHMIDTIA Urban, *Repert. Spec. Nov. Regni Veg.* 20: 312. 1924. RUBIACEAE, honoring Otto Schmidt, 1900–1956.
- OTTOSCHULZIA Urban, *Symb. Antill.* 7: 272. 1912. ICACINACEAE, honoring Otto Eugene Schulz, 1874–1936, botanist.
- OTTOSONDERIA Bolus, *Notes Mesembryanthemum*, pt. 3, 292. 1958. AIZOACEAE, honoring Otto Wilhelm Sonder, 1812–1881, botanist.
- PALMERVANDENBROECKIA Gibbs, *Arfak Mts.* 162. 1917. ARALIACEAE, honoring Ch. L. J. Palmer van den Broeck, government official (Resident of Ternate).
- PAULADOLPHIA Börner, *Abh. Naturwiss. Vereine Bremen* 21: 277. 1913. POLYGONACEAE, honoring Adolf Paul, ?-1910.
- PAULOMAGNUSIA Kuntze, *Revis. Gen. Pl.* 2: 702. 1891. IRIDACEAE, honoring Paul Wilhelm Magnus, 1844–1914.
- PAULO-WILHELMIA Hochst. *Flora* 27: 17. 1844. ACANTHACEAE, honoring Freidrich Paul Wilhelm.
- PETERAVENIA King & Robinson, *Phytologia* 21: 394. 1971. COMPOSITAE, honoring Peter Hamilton Raven, 1936–*, botanist.
- PLARODRIGOA Looser, *Revista Sudamer. Bot.* 2: 160. 1935. MALVACEAE, honoring América del Pilar Rodrigo Trigo, botanist.
- RADYERA Bullock, *Kew Bull.* 1956: 454. 1957. MALVACEAE, honoring Robert Allen Dyer, 1900–*, botanist.

- RAHOWARDIANA D'Arcy, Ann. Missouri Bot. Gard. 60: 671. 1973. SOLANACEAE, honoring Richard Alden Howard, 1917-*, botanist.
- RAULINOREITZIA King & Robinson, Phytologia 22: 113. 1971. COMPOSITAE, honoring Raulino Reitz, 1919-*, botanist.
- REEDROLLINSIA Walker, Rhodora 73: 461. 1971. ANNONACEAE, honoring Reed Clark Rollins, 1911-*, botanist.
- ROMANSCHULZIA O. Schulz, Engl. Pflanzenr., Crucif.-Sisymb. 144. 1924; Bot. Jahrb. Syst. 64: 99. 1933. CRUCIFERAE, honoring Roman Schulz, 1873–1926.
- ROYSTONEA Cook, Science, ser. ii, 12: 479. 1900. PALMAE, honoring General Roy Stone, 1835–1905, U.S. Army Engineer.
- SEBASTIANO-SCHAUERIA Nees, Mart. Fl. Bras. 9: 158. 1847. ACANTHACEAE, honoring Sebastian Schauer, botanist.
- SINOWILSONIA Hemsley in Hooker, Icon. Pl. t. 2817. 1906. HAMAMELIDACEAE, honoring Ernest Henry "Chinese" Wilson, 1876–1930, plant collector and horticulturist.
- SIRHOOKERA Kuntze, Revis. Gen. Pl. 2: 681. 1891. ORCHIDACEAE, honoring Sir Joseph Dalton Hooker, 1817–1911, botanist.
- SIRMUELLERA Kuntze, Revis. Gen. Pl. 2: 581. 1891. PROTEACEAE, presumably honoring Sir Ferdinand Jacob Heinrich ("Baron") von Mueller, 1825–1896, botanist.
- SVENHEDINIA Urban, Repert. Spec. Nov. Regi Veg. 24:3. 1927. MAGNOLIACEAE, honoring Sven Anders Hedin, 1865–1952, explorer.
- THOMANDERSIA Baillon, Hist. Pl. 11: 456. 1891. ACANTHACEAE, honoring (?) Thomas Anderson, 1832–1870.
- WILLRUSSELLIA A. Chevalier, Bull. Soc. Bot. France 84: 503. 1938. LILIACEAE, honoring William Russell, 1860–1946, botanist.
- WILLWEBERA Löve & Löve, Lagascalia 4: 9. 1974. CARYOPHYLLACEAE, honoring William A. Weber, 1918-*, botanist.

FORMATION OF NAMES

The majority of these names are formed in a straightforward manner by combining the given name and the surname, with or without a hyphen or connecting vowel, and providing a suitable ending (e.g. *Edithcolea*, *Roystonea*). In other cases the given name is first latinized before making the combination (e.g. *Carolofritschia*, *Carlostephania*, *Joannegria*).

An interesting variation on this method is to use the person's title in lieu of the given name, for example *Captaincookia*, which perhaps more readily identifies the honoree than had his given name James been used. The names *Sirhookera* and *Sirmuelleria* however, are ambiguous. The former name could honor Sir William Jackson Hooker, the father, or Sir Joseph Dalton Hooker, the son. Fortunately, the author of the name stated explicitly that the name honors Sir Joseph. In the case of *Sirmuelleria*, one can only

presume that this name was intended to honor Baron F. von Mueller (Sir Ferdinand in 1879), since the author made no clear dedication.

In several cases an individual's second given name (middle name) is combined with the surname to form the generic name. Examples are: *Allenrolfea*, *Barkerwebbia*, *Burttdavya*, *Donnellsmithia*, *Harlanlewisia*, *Harrysmithia*, *Juttadinteria*, *Kingdon-Wardia*, and *Maxburretia*. These names generally result from the individual's preference of the second over the first name, but in some cases it is unclear if the name was formed as just described (clearly the case for *Allenrolfea*, *Harlanlewisia*, *Harrysmithia*, *Juttadintera* and *Maxburretia*) or if it was formed from a hyphenated surname.

Some names are formed by ellipsis. The most ingenious example is *Elmerrillia*, which takes advantage of the fact that the last syllable of "Elmer" and the first syllable of "Merrill" are identical. The same method was used to coin *Peteravenia*, dropping only a single letter. Other examples of ellipsis are *Edbakeria* (from Edmund Baker), *Elidurandia* (from Elias Durand), *Lenbrassia* (from Leonard Brass), and *Willwebera* (from William Weber). An especially cryptic example of condensation is *Plarodrigoa* (from América del Pilar Rodrigo T.), which almost amounts to an anagram. An additional form of condensation includes those names that use only initials, rather than the full given name. Examples are: *Acsmithia*, *Ifdregea*, *Jarandersonia*, *Nebrownia*, *Radyera*, and *Rahowardiana*. In the case of *Ifdregea*, the initial J. is first latinized to I. (cf. Article 73.5).

A particularly interesting name, *Sinowilsonia*, is based on the nickname of "Chinese" Wilson. Some of the condensed names of the preceding paragraph (e.g. *Lenbrassia*, *Maxburretia*, *Willwebera*) also may be better regarded as based on nicknames than on ellipsis, although the distinction may be of little moment.

FREQUENCY OF PUBLICATION

The tabulation gives more than 70 *nomina perpropria* from as early as 1800 (*Caroli-Gmelina*) until the present. The names have been published throughout almost two centuries by many authors. Many of them appeared in the 1890's largely as a result of the nomenclatural reforms proposed by Otto Kuntze. The frequency of publication in the present century has been significantly greater (ca 5 or more names per decade) than in the preceding century (only 1 or 2 names per decade). This increased frequency seems reasonable, inasmuch as the simpler dedicatory names (surname only) are progressively utilized so that variant names are needed for distinctiveness. Examples in point are the names *Enriquebeltrania* and *Joannegria*, which were proposed as *nomina nova* to replace *Beltrania* Miranda and *Negria* Chiovenda, respectively, both of which were found to be later homonyms.

LENGTH OF NAMES

The names in the accompanying list vary in length from several with only four syllables to three with seven syllables. One of the former (*Radyera*) may be considered to have either three or four syllables, depending upon pronunciation. "Rad-yér-a" has fewer syllables, but "Ra-dy-er-a" seems preferable, considering the derivation of the name. The modal value for name length is five syllables, though names of six syllables are virtually as numerous.

The length of names may also be measured by their number of letters. The two longest names in the list are *Johannesteijsmannia* and *Palmer-vandenbroeckia*, with 19 and 20 letters respectively; both have seven syllables.

How do these values compare with length of names generally? A random sample of generic names (ten random pages, 263 names) was extracted from Willis' *Dictionary* (Airy Shaw, 1966). The *nomina perpropria* listed here are clearly longer than those of the random sample. The former have a modal value of 5–6 syllables, the latter of 4–5 syllables. The difference of one syllable does not seem to be a major obstacle to the continued use of *nomina perpropria*. The random list, however, produced no names of seven or more syllables and very few (less than 4%) of six syllables. It thus appears that the *nomina perpropria* potentially are of excessive length if not formed judiciously.

The two names noted above that are longest (in number both of letters and of syllables) are quite pronounceable, but are none the less rather daunting to the eye when they appear on the printed page. In fact, I know of only two other generic names that are 20 letters long (*Cuatrecasasiodendron* Standley & Steyermark and *Austrocylindropuntia* Backeberg) and none that are longer, except for the names of certain intergeneric orchid hybrids, where some feel it appropriate to record the parentage of the hybrid in the name itself by simply stringing together two, three, or even four generic names. Thus are achieved such graceless monstrosities as *XPhaiolimatopreptanthes* Hort. and (may I be forgiven for even citing it) *XBrassosopphrolaeliocattleya* Hort. In comparison with such competition, names like *Johannesteijsmannia* and *Palmervandenbroeckia* fairly roll off the tongue.

My point is that extra-long names can be formed by various methods and are not peculiarly associated with the *nomina perpropria* discussed here. It should be noted that, in the list presented, several names may be found with only nine letters and one (*Radyera*) with only seven, these names not being of excessive length by any standard.

Thus, to return to my colleagues' good-natured remarks about so "unwieldy" a new name as *Billieturnera*, I suspect that some of them were merely objecting to the newness of the name and not to its mode of forma-

tion. After all, names that become familiar through usage, such as *Carlowrightia* or *Roystonea*, cease to be remarked upon and are simply used to communicate about plants, which is what botanical names are for.

REFERENCES

- AIRY SHAW, H. K. 1966. A dictionary of the flowering plants and ferns. Cambridge University Press (by J. C. Willis, seventh edition edited by H. K. Airy Shaw).
- LINNAEUS, C. 1938. The *Critica Botanica* of Linnaeus (1737). Translated by A. Hort, revised by M. L. Green. London.
- STAFLEU, F. A. et al. (edit.) 1978. International code of botanical nomenclature. Bohn, Scheltema, & Holkema: Utrecht.
- STEARNS, W. T. 1966. Botanical Latin. Hafner: New York.

TRICHOMES AND STOMATA OF *GORDONIA LASIANTHUS* (THEACEAE)

LORAN C. ANDERSON

*Department of Biological Science, Florida State
University, Tallahassee, FL 32306*

ABSTRACT

Study of trichomes and stomata on epidermal surfaces using the scanning electron microscope is presented with augmentation from sectioned and imprinted materials viewed using the light microscope. Trichomes always occur on flowers and abaxial leaf surfaces; they rarely occur on epidermis of mature twigs. The trichomes are mostly in fascicles of two to four parallel hairs; they vary in density and size. Stomata are cyclocytic with prominent stomatal rims and peristomatal rims, the latter usually in the form of buttressed cups. Comparisons are made with trichomes and stomata of related taxa.

The loblolly bay, *Gordonia lasianthus* (L.) Ellis, ranges from medium-sized shrubs to handsome trees up to 84 feet tall. It has leathery evergreen leaves and occurs in bay forests, low woods, and ti-ti swamp margins on the coastal plain from North Carolina to Florida, west to Mississippi. All other species of *Gordonia* (ca 30) occur in Asia.

Most writers (Bailey, 1949; Kurz and Godfrey, 1962; Radford et al., 1964; Small, 1933; and Wood, 1959) describe the leaves of *G. lasianthus* as glabrous; however, Metcalfe and Chalk (1950) recorded foliar hairs in fascicles with unicellular rays for *Gordonia* and *Ternstroemiopsis* (= *Eurya*) without reference to any particular species. Keng (1962), in his extensive treatment of the Theaceae, noted Metcalfe and Chalk's statement but wrote: "I observed such trichomes only in *Franklinia al{a}tamaha* and *Laplacea grandis*. They are not found in *Gordonia axillaris*, *G. gigantiflora*, *G. lasianthus*, or *Eurya* . . ." (p. 289). He later stated (p. 350) without further elaboration that: "*Franklinia* and a few species of *Gordonia* and *Laplacea* possess stellate hairs."

Godfrey and Wooten's description (1981) of pubescence on abaxial leaf surfaces of *G. lasianthus* (Fig. 1) prompted this survey of trichomes and, incidentally, stomatal patterns in the species. A study of related taxa is underway.

MATERIALS AND METHODS

Live plants were collected from 13 counties in Florida and one each in North Carolina and South Carolina. Some materials were supplied by C. A. Aulbach-Smith, R. K. Godfrey, D. W. Hall, J. B. Nelson, T. Nifong, and

A. G. Shuey; their help is appreciated. Herbarium specimens were examined from other areas. Vouchers are filed at FSU.

Fresh plant tissues were used for observation with the scanning electron microscope (SEM). Abaxial surfaces of flower parts and leaves were studied in addition to twig and petiole surfaces. Suitable portions were vacuum

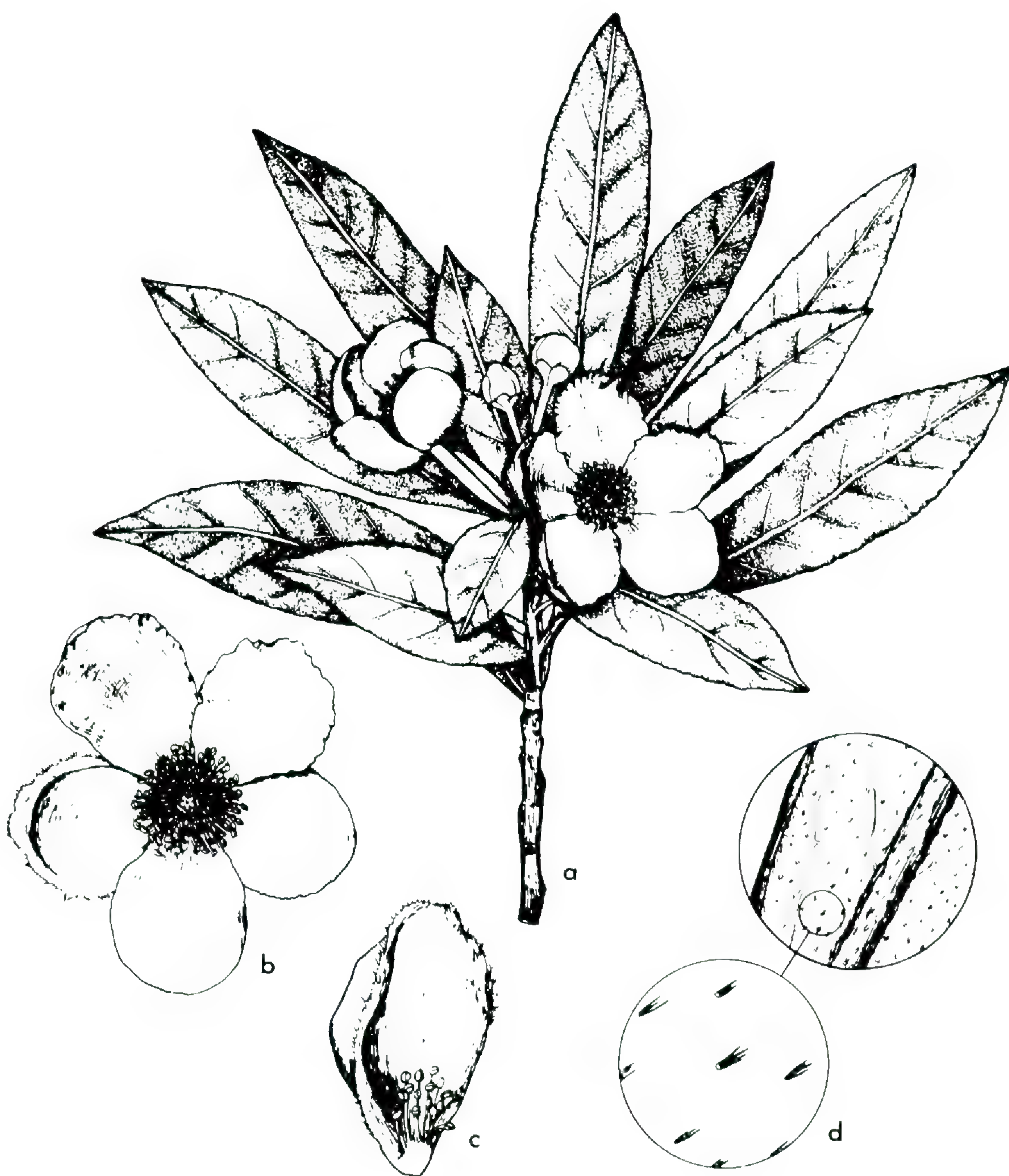


Fig. 1. *Gordonia lasianthus*: a. flowering branch; b. flower, face view; c. petal with one lobe of staminal cup appressed to the base; d. portion of abaxial leaf surface with enlargement of smaller portion showing pubescence.

dried, then sputter coated with 100–200 Å of AuPd (60/40). SEM micrographs were taken on a Cambridge Stereoscan S4-10 at 10–20 keV.

Delicate plant parts are usually prepared for SEM study by critical-point drying. The quicker technique employed here is possible because of the leaf texture and gives equally fine results. Trichome and stomatal measurements were made from epidermal peels (Duco cement imprints) of leaf surfaces. The epidermal peels, from fresh leaf surfaces, confirmed that no artifacts were introduced by the drying and coating processes used for SEM study.

Preserved leaves were embedded, sectioned, and stained through standard microtechniques. Floral parts had to be partially dissected for study because of trichome densities. Average trichome lengths (i.e., mean longest trichomes) were determined from measurements of the longest hairs in over 150 fascicles; individual hairs of the fascicle are nearly equal in length in all instances, so measuring the longest is suitable for comparison. From 50 to 100 measurements were taken to determine averages of other features listed in the tables. Stomatal terminology follows Wilkinson (1979).

RESULTS

TRICHOMES. The most noticeable pubescence in terms of trichome abundance and length occurs on the flowers (Table 1). Sepals (Fig. 2) have prominent ciliate margins with smaller hairs on mid regions of the abaxial surfaces; they are less numerous toward the sepal base. Adaxial and basal abaxial surfaces are glabrous.

Corolla aestivation is imbricate. Trichome abundance and distribution are related to petal position in the bud. The outermost petal has a prominent, continuous marginal fringe like that of the sepals, but the trichomes are usually longer. The abaxial surface of the outermost petal is covered with shorter hairs (Fig. 3). On the inner petals, hairs occur less abundantly and on the basal portions of the petals (areas less likely to be covered by the outer petals in bud). Sclereid distribution within the petals follows trichome patterns on the surface; i.e., if trichomes are restricted to the basal portion of the petal then the sclereids are also.

The stamens are glabrous. The ovary is uniformly covered with a dense coat of hairs (similar to those in Fig. 3 but straighter), and the stigma is glabrous. Floral trichomes are single-celled and occur individually or more commonly in fascicles of two, three, or four. Average lengths of floral trichomes are given for selected collections in Table 1.

Most mature branches of *Gordonia lasianthus* are glabrous; younger twigs may have some pubescence near the petioles. Only two patches of scurfy hairs were found on older branches that were otherwise glabrous. In *Anderson 5338* (Fig. 4), the hair fascicles are closely appressed to the twig, whereas in *Aulbach-Smith 1506* (Fig. 5), the hairs of the fascicles are more erect and divergent.

Table 1. Mean trichome lengths (μm) on flower parts of *Gordonia lasianthus*.

Locality and collection	sepal margin	SEPAL abaxial side	petal margin	PETAL abaxial side	ovary surface
Gadsden Co., FL					
Anderson 5976	682.5	255.7	975.7	347.6	477.3
Anderson 5977	711.1	203.3	921.6	290.2	445.5
Leon Co., FL					
Anderson 5338	480.0	288.0	857.9	209.1	475.4
Colleton Co., SC					
Aulbach-Smith 1506	858.7	294.2	553.6	176.8	451.2

Petioles are very short in the loblolly bay and usually have a few black scurfy hairs, as viewed with a hand lens. Extreme examples are covered with hairs that lie flat on the surface (Fig. 6).

Leaf blades are glabrous adaxially, but all that have been examined have fascicled hairs on the abaxial surfaces; these are generally directed toward the leaf tip (Fig. 1-d, 7). The hairs are short, transparent, and often unobserved under a hand lens unless the light angle is favorable. The hairs are thick-walled and strongly birefringent under polarized light; however, cleared whole mounts of leaves are not conducive to study of hairs because of the abundance of idioblastic, branched sclereids in the mesophyll. Hairs are precocious and, therefore, more crowded on developing leaves (Fig. 8). Immature hairs are often crooked (Fig. 8) and partially collapsed (because of SEM vacuum). Mature hairs are mostly straight with smooth, firm surfaces; a few samples were observed with wax depositions on the hairs in the form of warty or crustose flakes. Members of a fascicle are nearly always unequal in length but more or less parallel (Fig. 10–13); only rarely are they widely spreading.

Data of fascicle composition, abundance, and size are given in Table 2. Intraplant measurements came from separate leaves of the same plant and intrapopulation measurements from separate but adjacent plants. Collections in each category are listed by increasing trichome density.

The fascicles are appressed (Fig. 7) and contain two to seven individual hairs (Fig. 8–13) with two and four being the most abundant groupings. Rarely, single hairs are found. Average fascicle density on mature leaves ranges from 2.38 to 7.45 fascicles per mm^2 . Mean foliar trichome lengths ranged from 109.5 to 210.4 μm , whereas individual extremes were 57.6 and 432.0 μm long.

STOMATA. Composition of the stomatal apparatus is not observable from surface views (SEM or epidermal peels) because it is hidden by heavy



Fig. 2-7. SEM micrographs with tip of organ to right. 2. Sepal tip, *Anderson 5338*, 40X. 3. Petal near tip, *Anderson 5338*, 280X. 4. Twig with appressed, arachnoid fascicles, *Anderson 5338*, 240X. 5. Twig with ascending fascicles, *Aulbach-Smith 1506*, 240X. 6. Abaxial petiolar region with tightly packed, appressed fascicles, *Aulbach-Smith 1506*, 335X. 7. Leaf surface, low oblique view (30°) showing appressed nature of four-celled fascicle of hairs and cuticular relief, *Hall 610*, 520X.

cuticular relief. Sectioned material reveals the stomatal guard cells are raised and rest upon the subsidiary cells (Fig. 14). Most stomata are cyclocytic with three subsidiary cells (tricytic) surrounding the guard cells (Fig. 15).

Table 2. Means for abaxial leaf surface features of *Gordonia lasianthus*.

Locality and collection	Fascicles per mm ²	Trichomes per fascicle	Trichome length, μ m	Stomata per mm ²
INTRAPLANT				
Wakulla Co., FL				
Anderson 5822-1	3.76	2.63	163.4	281.1
Anderson 5822-2	4.11	2.65	136.5	290.9
Anderson 5822-3	4.25	2.73	201.5	312.8
INTRAPOPOPULATION				
Pender Co., NC				
Anderson 5728	2.42	3.37	115.3	457.6
Anderson 5727	2.44	3.02	169.4	405.3
Gadsden Co., FL				
Anderson 5755	4.97	2.22	145.7	295.7
Anderson 5757	5.12	2.19	146.4	304.2
Anderson 5758	5.16	2.38	129.8	312.8
Anderson 5756	5.24	2.13	136.2	322.5
INTERPOPOPULATION				
DeSoto Co., FL				
Anderson 5827	2.38	2.38	174.9	279.9
Volusia Co., FL				
Godffrey 78768	2.76	2.38	137.5	316.4
Clay Co., FL				
Anderson 5710	3.07	2.21	148.2	290.0
Jefferson Co., FL				
Nelson 2024	3.39	2.72	115.5	283.6
Franklin Co., FL				
Anderson 5821	3.76	2.32	137.6	262.9
Hardee Co., FL				
Anderson 5826	4.30	3.30	109.5	322.5
Alachua Co., FL				
Hall 610	4.88	2.29	136.8	378.5
Liberty Co., FL				
Anderson 5769	4.94	2.08	138.9	318.9
Manatee Co., FL				
Anderson 5825	4.99	3.35	210.4	334.7
Colleton Co., SC				
Albach-Smith 1506	5.23	2.80	176.2	390.7
Leon Co., FL				
Anderson 5338	5.25	2.32	159.6	367.5
Hillsborough Co., FL				
Anderson 5824	7.45	3.27	138.1	205.7



Fig. 8–13. SEM of foliar trichomes, leaf tip to the right. 8. Young leaf surface showing precocious trichomes not yet turgid and straight; stomata and cuticular patterns not fully developed, *Anderson 5759*, 250X. 9. Trichome bifurcate, primary stoma at upper left, *Anderson 5769*, 250X. 10. Mature leaf surface showing trichome fascicles and stomata, *Hall 610*, 70X. 11. Trichome with four cells in the fascicle, *Aulbach-Smith 1506*, 520X. 12. Trichome with three cells in the fascicle, *Anderson 5710*, 520X. 13. Trichome with two cells in the fascicle (bifurcate), *Hall 610*, 520X.

The subsidiary cells stain differentially in fast green-orange G combinations; they stain light green, whereas non-stomatal cells of the epidermis stain orange.

Average guard cell length for *Anderson 5338* is 26.5 μm ; that of primary or giant stomata averages 31.2 μm . Stomatal size can be measured only in sectioned material and, therefore, is not listed in Table 2 for other collections; however, stomatal densities from epidermal peels are given. Stomata are distinguishable by more than size differences. The standard stomata have three subsidiary cells that are periclinally oriented around the guard cells. Primary stomata have eight subsidiary cells (octocytic) that are larger and anticlinally oriented around the guard cells. The two size classes of stomata are further distinguished by cuticular patterns (see below).

Although stomata appear raised in sectioned material, they appear sunken in SEM surface view because of the cuticular patterns. The stomatal rims are raised into prominent funnel-like structures with long, narrow apertures that nearly hide the guard cells (Fig. 16–20). Stomatal rims are often finely reticulate rather than being smooth. In addition, their inner walls may be undulate or flat (Fig. 18).

The peristomatal rim or ridge is usually raised into a high buttressed cup (Fig. 9, 16). Oblique SEM views show the buttressing and height of the cup more clearly (Fig. 18). Of the populations studied, all but two have the peristomatal cup. Leaves of a population from Gadsden County, Florida, have concentric rings of peristomatal striae rather than the buttressed cup (Fig. 19–20). Five sampled trees all have these cuticular striations. *Anderson 4314* (Fig. 20) was the first sample of *Gordonia* observed in this study; data for the other four are listed in Table 2. One sample, *Anderson 5821*, taken from a tree in Franklin County, Florida, also has the peristomatal striae.

Primary or giant stomata on all samples have cuticular striations (Fig. 9, 17) rather than buttressed cups. The striae are not as abundant as in the Gadsden and Franklin County plants, but they extend into raised ridges at the ends of the stomata.

Fig. 14–20. Light and electron micrographs of stomatal features. 14. Leaf transection showing guard cells raised on supporting subsidiary cells of lower epidermis with portion of large idioblastic sclereid to the left, *Anderson 5338*, 300X. 15. SEM of paradermal section showing standard stomata each with three subsidiary cells (tricytic), *Anderson 5338*, 500X. 16. Stomata with prominent stomatal rims nearly hiding guard cells, peristomatal rims as buttressed cups, *Godfrey 78768*, 500X. 17. Primary or giant stoma with stomatal rim flanked by cuticular striae that extend as ridges from ends of the stoma, *Anderson 5728*, 500X. 18. High oblique view (60°) showing fine reticulum on two of the stomatal rims plus height and buttressing of peristomatal cups, *Anderson 5710*, 1000X. 19. Sample from Gadsden County without peristomatal ridges or cups with numerous cuticular striations surrounding each stoma and smooth interstitial cuticle, *Anderson 5756*, 500X. 20. Trichome and stomata from Gadsden County sample, note fungal hypha (frequent on some samples), *Anderson 4314*, 500X.

A final aspect of cuticular variation amongst the populations relates to the interstomatal surface. The cuticle may be relatively smooth (Fig. 19–20), rugose with interstitial epidermal walls apparent (partially seen in Fig. 13),



raised into striations between buttressed cups (Fig. 16), or raised into irregularly rounded or warty plateaus (Fig. 18).

DISCUSSION

Abaxial leaf hairs appear to be universal for the species, and the peristomatal cups are widespread. Only two populations from Gadsden and Franklin Counties, Florida, have been found that have peristomatal cuticular striae rather than buttressed cups. Recent surveys show additional Gadsden County populations (those in Table 1) possess the standard buttressed cup.

Correlations among features listed in Table 2 are not clearly indicated. One might expect trichome density to be negatively correlated with stomatal density. The two samples from North Carolina do have relatively low trichome densities and high stomatal densities, and the converse is true for the sample from Hillsborough County, Florida. But several exceptions can be seen; i.e., the DeSoto County, Florida, plant has the lowest trichome density and relatively low stomatal density, and the reverse correlation is found in samples from Leon County, Florida, and South Carolina.

Keng (1962) designated stomata in the Theaceae that had subsidiary cells as the "gordoniaceous type" and noted that, with few exceptions such as *Franklinia*, they generally characterized the subfamily Camellioideae. He illustrated tricytic stomata for species of *Hartia* and *Schima*, but he did not record the octocytic type found here in the primary stomata of *Gordonia lasianthus*.

My preliminary survey of related taxa reveals the fascicled trichomes are absent in 11 Asian species of *Gordonia*; single-haired trichomes are found on leaves of *G. axillaris*, *G. chrysandra*, *G. elliptica*, *G. obtusa*, and *G. penangensis*, whereas leaves of *G. balansae*, *G. luzonica*, *G. papuana*, *G. speciosa*, *G. welbournei*, and *G. zeylanica* are glabrous. The Asian species also appear to lack buttressed peristomatal cups, but SEM study of air-dried material is problematic because of artifacts in the cuticular pattern.

Of 17 species of *Laplacea* examined, leaves of *L. fruticosa* have bifurcate trichomes, those of *L. grandis* are stellate, and those of *L. acutifolia*, *L. alpestris*, *L. angustifolia*, *L. ceurtoensis*, *L. curtyana*, *L. haematoxylon*, *L. moaensis*, *L. obovata*, *L. portoricensis*, *L. reticularis*, and *L. tomentosa* have single-haired trichomes. Leaves of *L. cymatoneura*, *L. semiserrata*, and *L. speciosa* are glabrous. Recently, Keng (1980) merged the genus *Laplacea* into *Gordonia*.

Three species of the nine seen in *Schima* have bifurcate trichomes on abaxial leaf surfaces (*S. argentea*, *S. khasiana*, and *S. wallichii*), whereas leaves of *S. mertensiana* and *S. superba* have single-haired trichomes. Leaves of *S. confertiflora*, *S. crenata*, *S. noronhae*, and *S. sinensis* are glabrous. Buttressed stomata were not observed in *Schima*. Bloembergen (1952) considers *Schima* monotypic with *S. wallichii* having several subspecies. Cer-

tainly a more detailed study of variation, including foliar trichomes, is warranted for *Schima*.

Trichomes and stomata on leaves of *Stewartia* and *Franklinia* differ markedly from those of *Gordonia lasianthus*. *Stewartia* has numerous, uniseriate trichomes, and *Franklinia* has a mixture of single, bifurcate, and stellate hairs. Contrary to Keng's statements (1962), foliar stellate hairs were not observed on any species of *Gordonia* (sens. strict.) in my study, but fascicled trichomes do occur in *G. lasianthus*.

ACKNOWLEDGEMENTS

Thanks are due to W. I. Miller for electron microscopy, K. Womble for photography, and M. Darst for artwork.

REFERENCES

- BAILEY, L. H. 1949. Manual of cultivated plants. Macmillan Co., New York.
- BLOEMBERGEN, S. 1952. A critical study in the complex-polymorphous genus *Schima* (Theaceae). *Reinwardtia* 2: 133–183.
- GODFREY, R. K., and J. W. WOOTEN. 1981. Aquatic and wetland plants of southeastern United States. Dicotyledons. Univ. of Georgia Press, Athens.
- KENG, H. 1962. Comparative morphological studies in Theaceae. *Univ. Calif. Publ. Bot.* 33: 269–384.
- . 1980. On the unification of *Laplacea* and *Gordonia* (Theaceae). *Gard. Bull. Straits Settle.* (Part II) 33: 303–311.
- KURZ, H., and R. K. GODFREY. 1962. Trees of northern Florida. Univ. of Florida Press, Gainesville.
- METCALFE, C. R., and L. CHALK. 1950. Anatomy of dicotyledons. Oxford Univ. Press, London.
- RADFORD, A. E., H. E. AHLES, and C. R. BELL. 1964. Manual of the vascular flora of the Carolinas. Univ. North Carolina Press, Chapel Hill.
- SMALL, J. K. 1933. Manual of the southeastern flora. Univ. of North Carolina Press, Chapel Hill.
- WILKINSON, H. P. 1979. The plant surface. *In* anatomy of the dicotyledons, Vol. 1 (ed. C. R. Metcalfe and L. Chalk). Oxford Univ. Press, London.
- WOOD, C. E. 1959. The genera of Theaceae of the southeastern United States. *J. Arnold Arbor.* 40: 413–419.

VASCULAR FLORA OF KENTUCKY: ADDITIONS AND OTHER NOTEWORTHY COLLECTIONS

MAX E. MEDLEY

Department of Biology, University of Louisville, Louisville, KY 40208

RAY CRANFILL

Department of Botany, University of California, Berkeley, CA 94720

and

JOHN W. THIERET

*Department of Biological Sciences, Northern Kentucky University,
Highland Heights, KY 41076*

As the Kentucky Floristic Survey proceeds, herbarium and field studies have turned up many additional records since our last installment (Cranfill and Thieret, 1981). Judging from floras of surrounding states, we anticipate that the total number of species of vascular plants in Kentucky will exceed 2500. With the current total in the neighborhood of 2200, we expect a large number of species are still to be found within the state. The south central counties (Clinton to Monroe north to Pulaski and Taylor) have been largely neglected by collectors and offer a high potential for new discoveries.

Our objectives in this paper are two: (1) to present data on species that represent additions to Kentucky's flora or that have been collected only once or twice before in the state and (2) to validate the occurrence of certain species reported for Kentucky by Short, Peter, and Griswold (1833) and by McFarland (1942). The validation of these lists is important because some of these species have not been reported elsewhere from Kentucky and because the vouchers for McFarland's records were destroyed by fire in 1947.

We consider taxa to be additions to our flora if they have not been reported previously for the state. We also include in this category plants ascribed to Kentucky in the literature but for which no additional information is provided and for which we can find no voucher, taxa from unpublished graduate theses, and taxa from publications with a minimal distribution. We include previously reported species only if they represent a second or third occurrence for Kentucky, constitute an unusual range extension, or document the rapid spread of noxious weeds.

Additions to the state's flora are preceded by an asterisk. In addition to those abbreviations found in Holmgren, Keuken, and Schofield (1981), the

following are required: KES: Herbarium, College of Agriculture, University of Kentucky, Lexington, Ky.; KNPC: Herbarium of the Kentucky Nature Preserves Commission, 407 Broadway, Frankfort, Ky.; MRE: Herbarium of the Department of Biology, Morehead State University, Morehead, Ky.; and WKU: Herbarium, Department of Biology, Western Kentucky University, Bowling Green, Ky.

Our thanks go to B. E. Wofford (University of Tennessee) and J. MacGregor (Kentucky Department of Fish and Wildlife) for notes on particular species and to the curators of many herbaria who assisted our studies. Our very special thanks go to L. R. Phillippe and R. Hannan of the Kentucky Nature Preserves Commission who have given us several records reported herein.

THUJA OCCIDENTALIS (L.) BSP. Pulaski Co.: west facing limestone cliffs above Buck Creek on N side of KY 80, 15 May 1980; *Medley & Cranfill* 2094-80 (KNPC); east facing limestone bluffs above Buck Creek just N of KY 192, 20 Aug 1979, *Cranfill & Medley* 4793 (KY, MEM). *Arbor vitae* was rediscovered in Kentucky by Medley and Wofford (1980), who noted several small plants on a boulder in the Big South Fork in McCreary County. The present populations number tens of trees, some very old, with reproduction apparent, indicating a less precarious existence for this species in Kentucky.

**ALOPECURUS PRATENSIS* L. Campbell Co.: meadow-like area off Beiting Drive, Alexandria, 4 May 1975, *Thieret* 48449 (KNK). This species is introduced from Europe.

**ARTHRAOXON HISPIDUS* (Thunb.) Makino. Bracken Co.: in grass at edge of thickets along Ohio River just below Meldahl Lock and Dam, 13 Nov 1981, *Thieret* 52763 (KNK). This species, a native of Japan, has become a serious pest in states to the south (Radford, Ahles, and Bell, 1968) and may yet become so in Kentucky.

**GYMNOPOGON BREVIFOLIUS* Trinius. Pulaski Co.: drier mounds in sandy wet meadow near Hazel Dell Church, 1 mi W of KY 39 and 10 mi N of Somerset, 3 Oct 1978, *Hannan & Phillippe* 00600 (KNPC). According to Smith (1971), this species is nearly restricted to the coastal plain. Its occurrence in Kentucky, over 300 km from the nearest other station (in southern Tennessee) is remarkable.

**LEPTOLOMA COGNATUM* (Schult.) Chase. Fulton Co.: sandy woods, KY 313, 6.3 mi from Tennessee state line, 18 Aug 1968, *Fuller & Fuller* 261 (MUR). This species occurs in the two Missouri counties adjacent to Kentucky (Steyermark, 1963).

**PANICUM TEXANUM* Buckl. Campbell Co.: railroad yard, Silver Grove, rare, 17 Oct 1981, *Nienaber* 8 (KNK). This millet has been introduced into several southern states but has not become widely established.

**CAREX JOORII* Bailey. McCreary Co.: wet depression on N side of KY 92, ca 2.5 mi W of South Fork of Cumberland River, 31 Jul 1980, *Medley*

2704-80 (KNPC). This population forms several large tussocks in ditches on the north side of the road and is disjunct from populations in Cumberland County, Tennessee.

**CAREX LAXICULMIS* Schwein. Hardin Co.: dry, calcareous oak-hickory woods, 4 km W of Summit, 26 May 1979, *Cranfill* 4331 (KY, MEM). This species was reported by McFarland (1942) without locality.

**MURDANNIA KEISAK* (Hassk.) Hand.-Maz. Floyd Co.: swamp near headwaters of Dewey Lake, 6 mi E of Prestonsburg, 8 Aug 1982, *Thieret* 53752 (KNK). Knox Co.: along muddy edge of stream, 0.6 mi N of Dent along KY 223, 8 Jun 1978, *Camburn s.n.* (KNPC). Dennis et al. (1980) reported the spread of this species from northern Alabama to Tennessee in the TVA reservoir system.

**JUNCUS DUDLEYI* Wieg. Madison Co.: Central Kentucky Wildlife Management Center, 8 mi N of Berea, 11 Jul 1978, *Lassetter* 3049 (EKU, KNK). Rowan Co.: grassy, muddy shore of Cave Run Lake, 6 Aug 1977, *Thieret* 50187 (KNK). This rush occurs in Ohio (Braun, 1967) and is scattered throughout Tennessee.

**JUNCUS INTERIOR* Wieg. Pendleton Co.: damp, sandy beach of Kincaid Lake, 30 Jul 1977, *Thieret* 50107 (KNK). Rowan Co.: grassy, muddy shore of Cave Run Lake, 6 Aug 1977, *Thieret* 50183 (KNK). *Juncus interior* is a species of the plains and extends eastward in the Prairie Peninsula to Indiana with a single locality in central Ohio. Its occurrence in Kentucky probably represents an introduction.

**JUNCUS SECUNDUS* Beauv. ex Poir. Hardin Co.: rocky sandstone exposures along the Illinois Central Railroad near its junction with Old Meeting Creek Rd., 12 Aug 1979, *Cranfill* 5044 (KY, MEM). The present population is but a short distance from a Washington County, Indiana, station (Deam, 1940). As with the previous rushes, this species is inconspicuous and probably overlooked.

AMIANTHIUM MUSCAETOXICUM (Walt.) Gray. Harlan Co.: Briarfield Gap, 9.6 mi from Caywood, 28 Sep 1978, *Hannan & Phillippe s.n.* (KNPC). Bell Co.: Cumberland Gap National Historical Park, Cove at 2000 ft., 21 Jun 1974, *Hinkle* 49310 (TENN). These are the first collections of this species from Kentucky in over a century.

**ALLIUM BURDICKII* (Haynes) A. G. Jones. Oldham Co.: Pond Creek, wooded ravine, 12 May 1980, *Medley & Bryan* 1252-80 (KNPC).

PLATANThERA CRISTATA (Michx.) Lindl. McCreary Co.: scattered, edge of pond between old and new US 27, ca 1/2 mi N of state line, 31 Jul 1980, *Medley* 2718-80 (KNPC); streamhead seep ca 0.25 mi E of old US 27, just N of Tennessee state line, 3 Aug 1980, *Cranfill & MacGregor* 5269 (KY, MEM). Rogers (1941) reported finding a single individual of this species near Pine Knot, McCreary County. Our collections are the first in Kentucky in 40 years.

PLATANThERA PSYCODES (L.) Lindl. Harlan Co.: edge of small wooded

stream, and in grassy area, headwater of Clark Fork, top of Big Black Mountain, 12 Jun 1980, *Medley 2291-80* (KNPC). This is the first Kentucky collection of this species in 32 years.

**HEXASTYLIS CONTRACTA* Blomquist. McCreary Co.: mesophytic forest, South Fork of the Cumberland River, 6 Apr 1934, *Braun 656* (US). The occurrence of this species in Kentucky is not surprising since it is found throughout the Cumberland Plateau of Tennessee. The specimen was determined by Braun as *H. virginica* (L.) Small.

**ERIOGONUM LONGIFOLIUM* Nutt. var. *HARPERI* (Goodm.) Reveal. Christian Co.: prairie-like area between US 41 and railroad near Kelly, 28 Aug 1980, *Medley 2795-80* (KNPC). Our collection extends the range northwest from De Kalb, Putnam, and Wilson counties, Tennessee (Patrick, 1979; Watson and Rogers, 1972; Wofford and Dennis, 1976). Reveal (1968) reduced this rare plant to varietal status under *E. longifolium*, a plains species.

**SALSOLA KALI* L. Campbell Co.: along railroad tracks, Silver Grove, 4 Oct 1981, *Buddell 450* (KNK). Kenton Co.: along railroad tracks, Covington, 11 Aug 1978, *Applegarth 468* (KNK). Garman (1941) reported receiving a specimen of Russian thistle from Russellville, Logan County, and McFarland (1942) reported the species from Kentucky but without locality or citation of specimen. Most American authors treat the Russian thistle as *S. kali* var. *tenuifolia* G.F.W. Mey.

**AMARANTHUS PALMERI* S. Wats. Campbell Co.: along railroad tracks, Silver Grove, 27 Sep 1981, *Buddell 431* (KNK). A native of the southwest, *A. palmeri* is adventive east of Oklahoma and Texas.

**STELLARIA AQUATICA* (L.) Scop. Campbell Co.: in mat of *Eragrostis hypnoides* on sandy/silty shore of Ohio River, Silver grove, 27 Sep 1981, *Buddell & Thieret 481* (KNK).

**CERATOPHYLLUM MURICATUM* Cham. Logan Co.: in woodland pond with *Wolffiella*, Keysburg Rd., ca 2 mi W of Keysburg, 24 Apr 1982, *Thieret & Medley 52790* (KNK). This species was formerly known as *C. echinatum* Gray. According to Fassett (1953), it is confined mostly to the Mississippi Valley and northern Atlantic Coastal Plain.

**CALTHA PALUSTRIS* L. Jefferson Co.: marshes around Louisville, Jun 1884, *Museller s.n.* (KY). County not given: Beard Branch near Lexington, n.d., *Short s.n.* (PH). *Caltha* has not been found in Kentucky for nearly a century.

**CLEMATIS TERNIFLORA* DC. Bourbon Co.: bank of Stoner Creek, 4 Jun 1964, *Guhardja 128* (KY). Fayette Co.: abundant in fence row, 26 Jun 1980, *Cranfill 5039* (KY, MEM). Franklin Co.: empty lot in Frankfort, 5 Sep 1981, *Medley 3091-81* (KNPC). Hardin Co.: railroad yard, Elizabethtown, 25 Jun 1980, *Cranfill 5225* (KY, MEM). Few vines match the obnoxious behavior of *Lonicera japonica*; the present species—formerly known as *C. diosoreifolia* Levl. & Vaniot—is an exception.

**MAGNOLIA PYRAMIDATA* Bartram ex Pursh. Fulton Co.: bottomlands near the Mississippi River, ca 2/3 km downstream from Hickman, 10 Oct 1970, *Byrne 4* (KY). Leaf morphology, habitat, and geographic position lead us to the above determination—the specimen is sterile.

**CAMELINA MICROCARPA* Andrz. Campbell Co.: weedy roadside, NKU Campus, 21 May 1974, *Thieret 48221* (KNK). Although *C. microcarpa* was reported (without citation of specimens) as a component of the Kentucky flora by McFarland (1942) and Reed (1970), we have seen no material of it other than our own.

**DESCURAINIA SOPHIA* (L.) Webb ex Prantl. Campbell Co.: railroad yard, Silver Grove, 9 Jul 1974, *Thieret 48240* (KNK).

**RORIPPA AUSTRIACA* (Crantz) Besser. Campbell Co.: roadside, Highland Heights, 4 Jun 1976, *Thieret 48934* (KNK). *Rorippa* in North America was recently monographed by Stuckey (1972).

**DROSERA BREVIFOLIA* Pursh. Pulaski Co.: in low, bare spot in moist sandy meadow, just N of Hazel Dell Church, 15 May 1980, *Medley & Cranfill 2095-80* (KNPC, KY). The flat sandy meadows of Pulaski County bear some resemblance to the barrens of the Highland Rim of Tennessee where a number of coastal plain disjuncts occur. As with *Gymnopogon brevifolius*, the nearest station for this sundew is in Coffee County, Tennessee.

**DROSERA INTERMEDIA* Hayne. County not given ("Kentucky"): n.d., *Price s.n.* (KES). Dr. Ronald L. Stuckey of the Ohio State University has provided us with label data from a specimen of *D. intermedia*—"Licking River (Kentucky), Mr. Peck"—from the Short Herbarium (PH).

**SEDUM ACRE* L. Pulaski Co.: abundant on limestone outcrops in pasture on N side of KY 80, 13 Jun 1982, *Cranfill 5010* (KY, MEM). Clausen (1975) did not mention this species for Kentucky. We have not been able to verify Gunn's (1968) report.

**CHRYOSPLENIUM AMERICANUM* Schwein. Harlan Co.: Pine Mountain Settlement School, 6 May 1974, *Garrison s.n.* (KY). *Chrysosplenium* is characteristic of cold brooks in the southern Appalachians but is inconspicuous and often overlooked.

**PARNASSIA ASARIFOLIA* Vent. McCreary Co.: low sphagnum boggy, ravine, 12 Oct 1940, *Rogers 65* (MRE). This species is abundant in similar habitats in the northern Cumberland Plateau in Tennessee and was to be expected in Kentucky.

**PARNASSIA GRANDIFOLIA* DC. Clinton Co.: dripping, calcareous ledges above Seventy Six Fall, 28 Sep 1980, *Cranfill 5404* (KY, MEM). This species is scattered throughout the southern Appalachians and was to be expected in Kentucky. At this site it was associated with *Carex leptalea*, another rare Kentucky plant.

**GEUM LACINIATUM* Murr. Boyd Co.: along railroad tracks between Russell and Raceland, 6 Jun 1979, *Thieret 50982* (KNK). Campbell Co.: grassy, meadow-like area, Silver Grove, 30 May 1981, *Thieret 52584* (KNK).

**RHODOTYPOS SCANDENS* (Thunb.) Makino. Jefferson Co.: naturalized at base of limestone bluff, Louisville, 6 Nov 1981, *Medley & Hotchkiss* 3529-81 (DHL). The record in Gunn (1968) was from a cultivated specimen.

**SANGUISORBA CANADENSIS* L. Letcher Co.: edge of waterfall in Bad Branch, Pine Mountain, 5 Oct 1978, *Hannan & Phillippe* 00705 (KNPC). This collection constitutes a range extension of over 200 km westward from the mountains of Greenbriar County, West Virginia.

RHYNCHOSIA TOMENTOSA (L.) Hook. & Arn. Christian Co.: prairie-like area between US 41 & railroad, near Kelly, 28 Aug 1980, *Medley* 2794-80 (KNPC). Our material is var. *tomentosa* and extends the range of this taxon westward by about 175 miles (Gear, 1978).

**EUONYMUS ALATUS* (Thunb.) Regel. Jefferson Co.: naturalized along base of limestone bluff, Louisville, 6 Nov 1981, *Medley & Hotchkiss* 3530-81 (DHL). Reported by Martin et al. (1979) in a publication with limited distribution. The report by Gunn (1968) was possibly based on a cultivated specimen.

ACER SPICATUM Lam. Adair Co.: ca 7 mi N of Columbia, 6 Jul 1958, *Gibson* 129 (US). Harlan Co.: Big Black Mountain, dripping ledges along KY 160 at elevation of 1300 m, 3 May 1981, *Cranfill* 5429 (KY, MEM). Pulaski Co.: in loose rocky talus at foot of limestone bluffs along Buck Creek, KY 1003, 24 May 1979, *Cranfill & Meijer* 4212 (KY, MEM). We have been unable to verify the statement in Wharton and Barbour (1973) that *A. spicatum* "was reported a century ago in four [Kentucky] counties of the Cumberland Plateau." According to our records, this species had been verified in Kentucky from only Carter County, Braun, 1943). The above-cited collections represent significant range extensions to the south and west. The Pulaski and Carter county sites are microclimatically similar due to issuance of cool, subterranean air that moderates summer heat. Like *Maianthemum canadense* and *Taxus canadensis*, *A. spicatum* was pushed south by Pleistocene glaciation and has persisted in suitable sites.

**RHAMNUS FRANGULA* L. Jefferson Co.: along railroad, Louisville, 6 Jun 1979, *Thieret* 50982 (KNK). This species is becoming a pest in bogs and riparian situations in states north of Kentucky.

**HERACLEUM LANATUM* Michx. Harlan Co.: wooded ridge in oak-hickory forest, on state line gravel rd. N of KY 160, Big Black Mountain, 12 Jun 1980, *Medley* 2280-80 (KNPC). This species was photographed by Braun (1940) in Letcher County but not collected. The present specimen verifies the occurrence of cow-parsnip in the state.

**LEUCOTHOE RECURVA* (Buckley) Gray. Letcher Co.: adjacent to rock outcrop, 1 stream km NE of mouth of Bad Branch, Pine Mountain, 15 Jul 1980, *Harker & Phillippi* s.n. (KNPC). This species, restricted to the southern Appalachians, was to be expected in Kentucky.

*RHODODENDRON MINUS Michx. Bell Co.: rocky ledges above Colmar, 15 Jun 1973, *Carr s.n.* (KY). McCreary Co.: woods by road leading into Cumberland Falls State Park, 1 Aug 1980, *Medley & Rogers 2744-80* (KNPC). The Bell County station has probably been extirpated by strip mining. The McCreary County population, the first for the Cumberland Plateau, may represent an introduction. It is interesting to note, though, that *Leiophyllum* is also known from the area. Both stations are considerably to the north and west of those reported by Duncan and Pullen (1962).

*NYMPHOIDES PELTATA (Gmel.) Kuntze. Bullitt Co.: shallow water at edge of small lake, 8 Sep 1981, *Medley & Hotchkiss 3141-81* (DHL). Stuckey (1974) provided an account of the introduction and spread of this species in North America.

*MATALEA CAROLINENSIS (Jacq.) Woodson. Cumberland Co.: 12 mi N of Burkesville on KY 61, roadside, 14 Jun 1972, *Anderson 8* (WKU). This species was credited to Kentucky by Radford, Ahles, and Bell (1968); we found no voucher at NCU. The stations nearest to the present collection are over 100 km away in the central basin of Tennessee.

*ELLISIA NYCTELEA (L.) L. Campbell Co.: weed in yard, Dayton, 7 May 1981, *Buddell 280* (KNK). Previously reported by Nelson (1919) but no voucher is known. Constance (1940) noted the potential weediness of this species.

*CYMBALARIA MURALIS Gaertn., Mey., & Schreb. Franklin Co.: Clinton St., limestone walls, Frankfort, 9 Sep 1978, *Medley & MacGregor 271-78* (KY). Previously reported by Garman (1914) without locality or citation of specimen.

*MECARDONIA ACUMINATA (Walt.) Small. Pulaski Co.: ditch near Hazel Dell Church, 25 Aug 1979, *Medley & Cranfill 1592-79* (KNPC). Simpson Co.: moist soil, roadside, US 31 W, 0.125 mi S of Warren County line, 20 Aug 1978, *Medley 237-78* (KNPC). This species was not reported for Kentucky by Pennell (1935).

*VERONICA HEDERAEFOLIA L. Campbell Co.: in wooded ravine, Silver Grove, 20 Apr 1979, *Thieret s.n.* (KNK). Franklin Co.: wooded slope, S of Leawood Dr., behind apartment building, 12 May 1978, *Medley 033-78* (KNPC). This speedwell was reported in Martin et al. (1979), but the publication had a limited distribution.

*OROBANCHE RAMOSA L. Woodford Co.: parasitic on roots of tobacco, Van Shipp farm on Old Frankfort Pike, 15 Aug 1977, *Cranfill 2846* (KY, MEM). Previously reported by Garman (1914) from Kentucky hempfields but without citation of specimen or locality.

*GALIUM MOLLUGO L. Campbell Co.: grassy roadside, Silver Grove, 15 May 1981, *Buddell 283* (KNK). Kenton Co.: weedy roadside, 1 mi W of Bromley, 1 Jul 1978, *Applegarth 275* (KNK). Lewis Co.: shallow ditch, S side Holly Branch Rd., 31 May 1980, *Medley 2265-80* (KNPC).

*VIBURNUM OPULUS L. var. OPULUS. Campbell Co.: shrubby area at

edge of woods, Bellevue, 15 Oct 1973, *Thieret* 41273 (KNK). Kenton Co.: shrub to 8 ft, in *Fraxinus-Robinia* woods 0.3 mi NE of Fort Mitchell, 10 Sep 1976, *Applegarth* 145 (KNK).

**CAMPANULA RAPUNCULOIDES* L. Fayette Co.: weed among shrubs adjacent to Chemistry-Physics Building, University of Kentucky campus, Lexington, 31 May 1977, *Grayum* 718 (KY). These plants were still persisting in 1982; presumably they are a garden escape.

**ASTER TATARICUS* L.f. Campbell Co.: large colony on slope above road, California, 27 Sep 1980, *Thieret* 52456 (KNK). Carter Co.: roadside near Carter Caves State Park, 4 Oct 1978, *Medley* 416-78 (KNPC). This species is an escape from gardens.

**CREPIS CAPILLARIS* (L.) Wallr. Campbell Co.: weedy area, Highland Heights, 26 Jun 1978, *Thieret s.n.* (KNK). Reported by Harvill (1941) for Fayette County; we have seen no collections other than our own.

REFERENCES

- BRAUN, E. L. 1940. An ecological transect of Black Mountain, Kentucky. *Ecol. Monogr.* 10: 193-241.
- . 1943. An annotated catalog of spermatophytes of Kentucky. Published by the author, Cincinnati. 161 pp.
- . 1967. The Monocotyledonae. Cat-tails to orchids. Ohio State University Press, Columbus, Ohio. 464 pp.
- CLAUSEN, R. T. 1975. *Sedum* of North America north of the Mexican Plateau. Cornell University Press, Ithaca, New York. 742 pp.
- CONSTANCE, L. 1940. The genus *Ellisia*. *Rhodora* 42: 33-39.
- CRANFILL, R. and J. W. THIERET. 1981. Thirty additions to the vascular flora of Kentucky. *Sida* 9: 55-58.
- DEAM, C. C. 1940. Flora of Indiana. Department of Conservation, Division of Forestry, Indianapolis, Indiana. 1236 pp.
- DENNIS, W. M., D. H. WEBB, E. B. WOFFORD and R. KRAL. 1980. State records and other recent noteworthy collections of Tennessee. III. *Castanea* 45: 237-242.
- DUNCAN, W. H. and T. H. PULLEN. 1962. Lepidote rhododendrons of the southeastern United States. *Brittonia* 14: 290-298.
- FASSETT, N. C. 1953. North American *Ceratophyllum*. *Commun. Inst. Trop. Invest. Ci. Univ. El Salvador* 2: 25-45.
- GARMAN, H. 1914. Some Kentucky weeds and poisonous plants. *Bull. Kentucky Agric. Exp. Sta.* 183: 255-339.
- GREAR, J. W. 1978. A revision of the New World species of *Rhynchosia* (Leguminosae, Faboideae). *Mem. New York Bot. Gard.* 31(1): 1-168.
- GUNN, C. R. 1968. The flora of Jefferson and seven adjacent counties, Kentucky. *Ann. Kentucky Soc. Nat. Hist.* 2: 1-322.
- HARVILL, A. M. 1941. A contribution to the Compositae of Kentucky. Master's thesis, University of Kentucky, Lexington, Kentucky. 85 pp.
- HOLMGREN, P. K., W. KEUKEN and E. K. SCHOFIELD. 1981. Index herbariorum. Part I. The herbaria of the world. 7th ed. *Regnum Veg.* 106: 1-452.
- McFARLAND, F. T. 1942. A catalogue of the vascular plants of Kentucky. *Castanea* 7: 77-108.
- MARTIN, W. H., W. S. BRYANT, J. S. LASSETTER and J. B. VARNER. 1979. The Kentucky River Palisades. Flora and vegetation. The Kentucky Chapter of the Nature Conservatory, [Lexington, Kentucky]. 240 pp.

- MEDLEY, M. E. and B. E. WOFFORD. 1980. *Thuja occidentalis* L. and other noteworthy collections from the Big South Fork of the Cumberland River in McCreary County, Kentucky. *Castanea* 45: 213–215.
- NELSON, J. C. 1919. Plants of Boone County, Kentucky. *Proc. Indiana Acad. Sci.* 28: 125–143.
- PATRICK, T. S. 1979. Final report: Upper Cumberland River flora project. Prepared for the Tennessee Heritage Program and the Ohio River Basin Commission. Department of Botany, University of Tennessee, Knoxville. 75 pp.
- PENNELL, F. W. 1935. The Scrophulariaceae of eastern temperate North America. *Acad. Nat. Sci. Philadelphia Monogr.* 1: 1–650.
- RADFORD, A. E., H. E. AHLES and C. R. BELL. 1968. Manual of the vascular flora of the Carolinas. University of North Carolina Press, Chapel Hill, North Carolina. 1183 pp.
- REED, C. F. 1970. Selected weeds of the United States. U.S.D.A. Agric. Handbook 366. 463 pp.
- REVEAL, J. L. 1968. Notes on the Texas eriogonums. *Sida* 3: 196–205.
- ROGERS, H. J. 1941. The flora of McCreary County, Kentucky. Master's thesis, University of Kentucky, Lexington, Kentucky. 111 pp.
- SHORT, C. W., R. PETER and H. A. GRISWOLD. 1833. A catalogue of the native phaenogamous plants, and ferns of Kentucky. *Transylvania J. Med. Assoc. Sci.* 6: 490–501.
- SMITH, J. P. 1971. Taxonomic revision of the genus *Gymnopogon* (Gramineae). *Iowa State Coll. J. Sci.* 45: 319–385.
- STEYERMARK, J. A. 1963. Flora of Missouri. Iowa State University Press, Ames, Iowa. 1725 pp.
- STUCKEY, R. L. 1972. Taxonomy and distribution of the genus *Rorippa* (Cruciferae) in North America. *Sida* 4: 279–430.
- . 1974. The introduction and distribution of *Nymphoides peltatum* (Menyanthaceae) in North America. *Bartonia* 42: 14–23.
- WATSON, J. R. and K. E. ROGERS. 1972. *Eriogonum harperi* Goodman in Tennessee. *Rhodora* 74: 154.
- WHARTON, M. E. and R. W. BARBOUR. 1973. Trees and shrubs of Kentucky. The University Press of Kentucky, Lexington, Kentucky. 583 pp.
- WOFFORD, B. E. and W. M. DENNIS. 1976. State records and other recent noteworthy collections of Tennessee plants. *Castanea* 41: 119–121.

A COMPARISON OF *POA TRACYI* AND *POA OCCIDENTALIS* (POACEAE: POEAE)¹

ROBERT J. SORENG AND STEPHAN L. HATCH

*Department of Biology, New Mexico State University, Las Cruces,
NM 88003, and Department of Range Science, Texas A & M University
College Station, TX 77843.*

ABSTRACT

Poa tracyi and *P. occidentalis* were found to be distinct, but closely related, species. Character differences between the taxa correspond to differences in breeding system, phenology, ecology, distribution, and possibly chromosome number. The species are rarely closely sympatric. Nevertheless, some intergradation and a few intermediate plants are apparent. Stepwise discriminant analysis correctly identified 99% of the 278 specimens tested. Geographic range of *P. tracyi* extends from northern Colorado to south central New Mexico; that of *P. occidentalis* from southwestern Colorado to southern New Mexico, east central Arizona and west Texas. New chromosome number reports are: *P. tracyi* $2n = 28$; *P. occidentalis*, $2n = ca\ 28$ with meiotic irregularities, and; *P. reflexa*, $2n = 28$. A key to *P. tracyi*, *P. occidentalis*, and similar species, *P. leptocoma*, *P. reflexa*, and *P. curta* is included.

INTRODUCTION

Poa tracyi Vasey and *P. occidentalis* Vasey are two closely related species, placed in the Palustres group by Hitchcock (1935), or the Leptocomae by V. L. Marsh (1950). Both are rather uncommon endemics to the mesic regions of the southern Rocky Mountains. A taxonomic problem arises from the morphological similarity of the taxa and the occurrence of intermediates, particularly in south central New Mexico. Marsh (ibid.) and Keck (unpublished typescript), in monographic treatments of the genus, maintained them as distinct species, a conclusion reported by Soreng (1980) and supported here. However, the separation of these taxa has been questioned by other authors. Wootton and Standley (1913), and Hitchcock (1935) doubted *P. tracyi* and *P. occidentalis* were distinct from one another, and as have Martin and Hutchins (1980), indicated that *P. tracyi* was known only from the type locality. Harrington (1954) called all Colorado specimens of these grasses *P. occidentalis* even though *P. tracyi* is actually the more widespread there.

Confused nomenclature, adds to the difficulty of understanding these taxa. Both have been described as *P. occidentalis*. *Poa occidentalis* Vasey was described from the type specimen of *P. trivalis* L. var. *occidentalis* Vasey,

¹ Submitted as Journal Article 968, New Mexico Agric. Exp. Sta., New Mexico State Univ., Las Cruces.

the latter a *nomen nudum*. *Poa tracyi* has a synonym, *P. flexuosa* Muhl. var. *occidentalis* Vasey, that was incorrectly raised to *P. occidentalis* (Vasey) Rydberg. *Poa occidentalis* (Vasey) Rydberg, is the later homonym, and is not synonymous with *P. occidentalis* Vasey. Weber and Johnston (1979), and Dorn (1977), accepting Keck's interpretation for Wyoming (1964), respectively call all Colorado and Wyoming material *P. tracyi*. However, they submerge *P. occidentalis* Vasey rather than *P. occidentalis* (Vasey) Rydberg under *P. tracyi*. This is the reverse of what Keck had done. Rydberg had published different names and synonymies for these species before he finally sorted this out in 1922.

In addition to nomenclatural confusion and morphological similarity between the taxa, their geographical distributions have been wrongly reported. *Poa occidentalis* Vasey has been reported from the Pacific States, Alaska, Utah, Wyoming, and western Canada, *Poa tracyi* from Montana, Idaho, Utah, and Wyoming apparently all on misapplications of these names. This and the long-term (and continuing) disparity over the taxonomic treatment of these taxa, led us to undertake this study.

MATERIALS AND METHODS

Poa occidentalis and *P. tracyi* were morphologically compared using samples from the region of geographic overlap between the taxa, and herbarium specimens from 23 herbaria. The results were combined with other biological data, to evaluate their taxonomic relationship. Population samples, observation on anthesis, and habitat data comes primarily from field work in the summers of 1978 through 1982, including 23 and nine different extensive collections of *P. occidentalis* and *P. tracyi* respectively. Some information on habitat was gleaned from specimen labels and floristic works. All voucher specimens are housed at NMC unless otherwise indicated.

Our sample for statistical analysis, after eliminating duplicate, incomplete, and immature specimens, include 23 *P. occidentalis* and 28 *P. tracyi* herbarium specimens, and 102 *P. occidentalis* and 125 *P. tracyi* population specimens. The four *P. occidentalis* populations used in discriminant analysis represent most of the geographic range of this species. Six populations of *P. tracyi* were used from the same general region. Collection locations are cited in Table 1, and are illustrated in Fig. 1.

Twenty-six morphological characters (Table 2) were measured and ranked in the following manner: Leaf sheath scabrosity, and ligule pubescence, 0 = absent, 1 = scant, or 2 = abundant; percent leaf sheath closure, 0 = 0-9%, 1 = 10-19%, 2 = 20-29% closed, etc.; lemma intermediate nerve distinctness, and between-nerve pubescence, 0 = faint or absent, or 1 = distinct; inflorescence emergence from the upper leaf sheath, 0 = lowest inflorescence node exerted more than 5 cm, 1 = lowest node exerted less than 5 cm, 2 = lowest node enclosed; and, portion of lemma keel and marginal nerve covered by pubescence as closest to, 0 = 0%, 1 = 25%,

TABLE 1. Collection locations of the population samples used in the comparison of *Poa occidentalis* and *P. tracyi*. N = the number of individuals examined in each population.

Poa occidentalis Vasey (4 populations). NEW MEXICO. Otero Co.: Sacramento Mts., Benson Ridge, 3 Aug 1979, *Soreng* 464 (N = 30). Bernalillo Co.: Sandia Mts., Dry Camp G.G., 14 Aug 1978, *Soreng & Hatch* 1 (N = 8). Santa Fe Co.: Sangre De Cristo Mts., ca 1 km S of Big Tesuque C.G. along Hyde Park Rd., 15 Aug 1978, *Soreng & Hatch* 10 (N = 27). Rio Arriba Co.: San Juan Mts., Rio Puerco C.G., 16 Aug 1978, *Soreng & Hatch* 48 (N = 29).

Poa tracyi Vasey (6 populations). NEW MEXICO. Lincoln Co.: White Mts., below Sierra Blanca Peak, 8 Aug 1979, *Soreng & Smith* 530 (N = 35). Bernalillo Co.: Sandia Mts., Sandia Crest N of tram, 16 Jul 1981, *Soreng & Gadzia* 1642 (N = 15). Colfax Co.: canyon N of Raton City Park, 11 Aug 1978, *Soreng & Hatch* 64 (N = 23); Raton Pass, on side on Bartlet Mesa, 22 Jul 1979, *Soreng* 385 (N = 28); ca 12 km NW of Raton, on the Raton Ranch, 25 Jul 1979, *Soreng* 401 (N = 22). Colorado. Huerfano Co.: E slope of the Sangre de Cristo Mts., Trinchera Peaks area, ca 8 km W of Cucharas Pass, 21 Jul 1979, *Soreng* 381 (N = 7).

2 = 33%, 3 = 50%, 4 = 66%, and 5 = 75%. The remaining characters were continuous except for number of branches at the lowest inflorescence node, number of florets per spikelet, and number of spikelets per longest branch. Seven more characters were generated by taking ratios of some of the continuous characters (Table 2).

The existence of two taxa was supported by differences between them in several characters states, particularly anther length. However, since some species have both long-anthered out-crossing populations and short-anthered inbreeding ones, additional evidence was needed. Therefore, phenology, breeding system, ecological data, and chromosome number were examined. Date of anthesis was estimated to the nearest month from 72 different collections. For 58 of these with exact dates of collection, more precise estimates were made to an early, mid, or late month date. All dates were used to study flowering time over the latitudinal range of each species. Only the more precise estimates were used to examine the overlap of flowering periods.

Differences in breeding system between the taxa were estimated by examining anther lengths, degree of floret openness, stigma exposure, and anther exertion from the floret on collected specimens in anthesis. All flowers had pistils. A plant was classified as perfect (at least in part) if at least one flower was found with developed anthers. If all the anthers on a plant were vestigial (i.e., obviously aborted), or absent, the plant was considered imperfect. Observations were also made on plants in the field and in a garden.

For chromosome data, meiotic material was fixed in ethanol-acetic acid (3:1), or ethanol-chloroform-acetic acid (4:3:1), and stained in alcoholic-hydrochloric acid carmine (Snow, 1963), or acetocarmine, and squashed in

a standard manner. Root tips were fixed and examined in a standard manner. The only chromosome number previously known for either species was $2n = 14$ for *P. occidentalis* (Hatch, 1980).

After it became evident that two morphologically and biologically distinct taxa were present, the data were submitted to the BMDP7M stepwise discriminant analysis (SDA) program (Dixon, 1975). This program also performs a modified canonical variates analysis (CVA) using the characters selected in the SDA. The SDA stepping process cut off level was an F-value of at least four to enter another character. Statistical distributions were examined for each character using Statistical Analysis Systems (SAS) (Barr et al., 1976) for basic statistics, character correlation matrices, and histograms. Only measured single characters appearing to have normal distributions were used in the SDA. Anther characters were used apriori to divide the groups for the SDA. However, anther-length was omitted in the analysis because in *P. tracyi* anthers may be either short and aborted or long and fertile.

RESULTS

MORPHOLOGY. *Poa occidentalis* and *P. tracyi* not only have a very similar aspect but broadly overlap in most of the continuous characters measured (Table 2). The characteristics of sheath scabrousness and panicle breadth, by which Hitchcock (1935) distinguishes these taxa, are not satisfactory to separate them. However, these taxa can be readily distinguished by a suite of characters which when considered together will separate nearly every individual. This suite of characters in turn corresponds to differences in phenology, breeding system, and habitat. In addition to anther length (the only character that does not overlap between these taxa), the most consistent discriminators are the openness of sheaths, and the ligule length-leaf blade width ratio. Some less constant features distinguishing them are the presence in *P. occidentalis* of more spikelets crowded on the branches, florets that are relatively smaller and less pubescent, and very scabrous sheaths. These features did not change when the taxa were grown in a common garden.

PHENOLOGY. The morphological distinction between the taxa corresponds to differences in flowering times. Flowering times for both taxa barely overlap locally (fig. 1), and generally become progressively later from north to south (fig. 2). *Poa tracyi* in south central New Mexico is an exception by flowering into mid-August, a fact probably significant in understanding the morphological variability of the species there. When *P. tracyi* from Raton, and *P. occidentalis* from Cloudcroft, New Mexico, were grown together in Las Cruces, New Mexico (a garden 610 m lower than their known elevational ranges), they flowered in May and June respectively, still maintaining a full month separation. Observation of these taxa in the field and garden reveals that plants flower over a short duration

TABLE 2. Means, standard deviations, ranges, and F values from tests of equality of means for characters used in the comparison of *Poa tracyi* and *P. occidentalis*. All metric character expressions are in mm. The first 12 characters are listed in the order in which they were selected in the stepwise discriminant analysis ($df = 1, 278$), the remaining characters have $df = 1, 293$. Significance for F values is indicated as follows: NS = $P > 0.1$; * = $P < 0.1$; ** = $P < 0.05$; *** = $P < 0.01$; blank = $P < 0.005$.

Character	POA TRACYI		POA OCCIDENTALIS		F-value
	$\bar{x} \pm SD$	Range	$\bar{x} \pm SD$	Range	
Sheath % closed	62 ± 3.3	(0-9)-(80-89)	36 ± 0.8	(20-29)-(50-59)	532
Palea length	3.0 ± 0.4	2.0-4.1	2.5 ± 0.3	1.7-4.0	167
Second glume length	3.2 ± 0.5	2.2-4.9	3.3 ± 0.4	2.6-4.6	9.5
Ligule length	2.0 ± 0.7	0.4-4.5	3.6 ± 1.4	1.0-12.2	148
Leaf blade length	115.7 ± 30.6	30-229	105.1 ± 30.0	35-180	9.3
First lemma length	3.8 ± 0.5	2.6-5.0	3.4 ± 0.4	2.6-4.9	68
Lemma keel pubescence	58 ± 0.7	(0-20)-(75-90)	48 ± 0.6	(0-20)-(75-90)	53
Leaf blade width	3.3 ± 0.9	1.5-5.6	2.9 ± 1.2	1.2-12.3	13
Florets per spikelet	3.2 ± 1.1	1-5	4.7 ± 1.0	1-7	24
Spikelet length	5.1 ± 1.0	2.9-8.1	4.7 ± 0.9	3.0-8.0	NS 1.8
Spikelets per longest branch	12.8 ± 5.3	3-35	34.2 ± 22.0	4-120	136
First glume	2.6 ± 0.4	1.6-3.5	2.8 ± 0.3	1.7-3.7	14
Inflorescence length	187 ± 40	80-283	198 ± 61	61-391	NS 0.5
Inflorescence width	87 ± 33	18-206	90 ± 53	13-265	NS 0.9
Inflorescence longest branch	80 ± 23	23-184	108 ± 37	27-227	56
Inflorescence # of branches at lowest node	2.8 ± 0.8	1-5	3.1 ± 1.1	1-7	**4.8
Inflorescence elongation	0.3 ± 0.5	0-3	1.1 ± 0.8	0-3	122
Plant height	691 ± 163	320-1245	549 ± 201	196-1115	52
Leaf sheath scabrosity	0.3 ± 0.5	0-2	1.7 ± 0.5	0-2	519
Leaf sheath length	103 ± 19	57-142	94 ± 32	38-194	***7.1
Leaf total length	218 ± 42	107-318	199 ± 57	73-338	9.0
Ligule pubescence	1.1 ± 0.7	0-2	1.8 ± 0.5	0-2	96
Lemma marginal nerve pubescence	38 ± 0.8	(10-20)-(75-85)	30 ± 0.7	(10-20)-(75-85)	65

Lemma between nerve pubescence	0.9 ± 0.3	0-1	0.4 ± 0.5	0-1	92
Distinctness of lemma intermediate nerve	0.4 ± 0.5	0-1	0.8 ± 0.4	0-1	46
Anther length (developed)	2.2 ± 0.4	1.2-3.0	0.6 ± 0.1	0.4-1.0	—
Plant sex	0.6 ± 0.5	0-1	1.0 ± 0.0	1-1	75

RATIOS

Panicle length/ Plant height	$28\% \pm 7.3$	16%-73%	$37\% \pm 6.1$	22%-59%	NS 0.6
Blade length/ Sheath length	$114\% \pm 29$	39%-260%	$117\% \pm 28$	56%-228%	NS 0.9
Ligule length/ Blade width	$64\% \pm 21$	8.8%-146%	$127\% \pm 33$	56%-227%	422
Palea length/ Lemma length	$80\% \pm 7.7$	58%-107%	$73\% \pm 5.7$	51%-94%	—
First glume/ First lemma	$69\% \pm 9.2$		$83\% \pm 7.2$		205
Second glume/ First lemma	$83\% \pm 9.1$		$99\% \pm 7.4$		255
Spikelet no. on/ Longest branch	$16\% \pm 6.1$		$31\% \pm 13.2$		157

(2-3 weeks), seeds mature, and plants do not normally produce reproductive shoots again during that season. A notable exception is *P. tracyi* from Clear Creek Co., Colorado, dated August (*Walker s.n.*), having a tiller in anthesis.

ASPECTS OF BREEDING SYSTEM. The apparent breeding behavior of these taxa supports the morphological and phenological distinctions between them. Four observations lead to the conclusion that the taxa have different breeding systems. 1) Differences in anther length and corresponding numbers of pollen grains: *Poa occidentalis* anthers range from 0.3-1 mm (mean 0.6 mm) in length. Fertile anthers of *P. tracyi* range from 1.25-3 mm (mean 2.2 mm) in length. Thus, *P. tracyi* anthers average four times the length of *P. occidentalis* anthers, a ratio that corresponds to the average numbers of pollen grains in their flowers (3000:600). 2) Deviations from wholly hermaphroditic flowers: Of 143 *P. tracyi* specimens 66% were perfect at least in part, 9% were estimated to be pistillate, lacking even vestigial anthers, and 25% were pistillate but had vestigial anthers. Thus, *P. tracyi* is partially gynodioecious. Abortive anthers were not found in *P. occidentalis*. 3) Variation in flower activity at anthesis: Florets of *Poa occidentalis* rarely open during anthesis. Pollen is abundant inside the florets, and their small stigmas are rarely even shortly exerted. The dehiscent anther sacs of this taxon, only slightly protruding from mature florets, appear to have been pushed out by developing caryopses. In contrast, florets in *P. tracyi* mostly

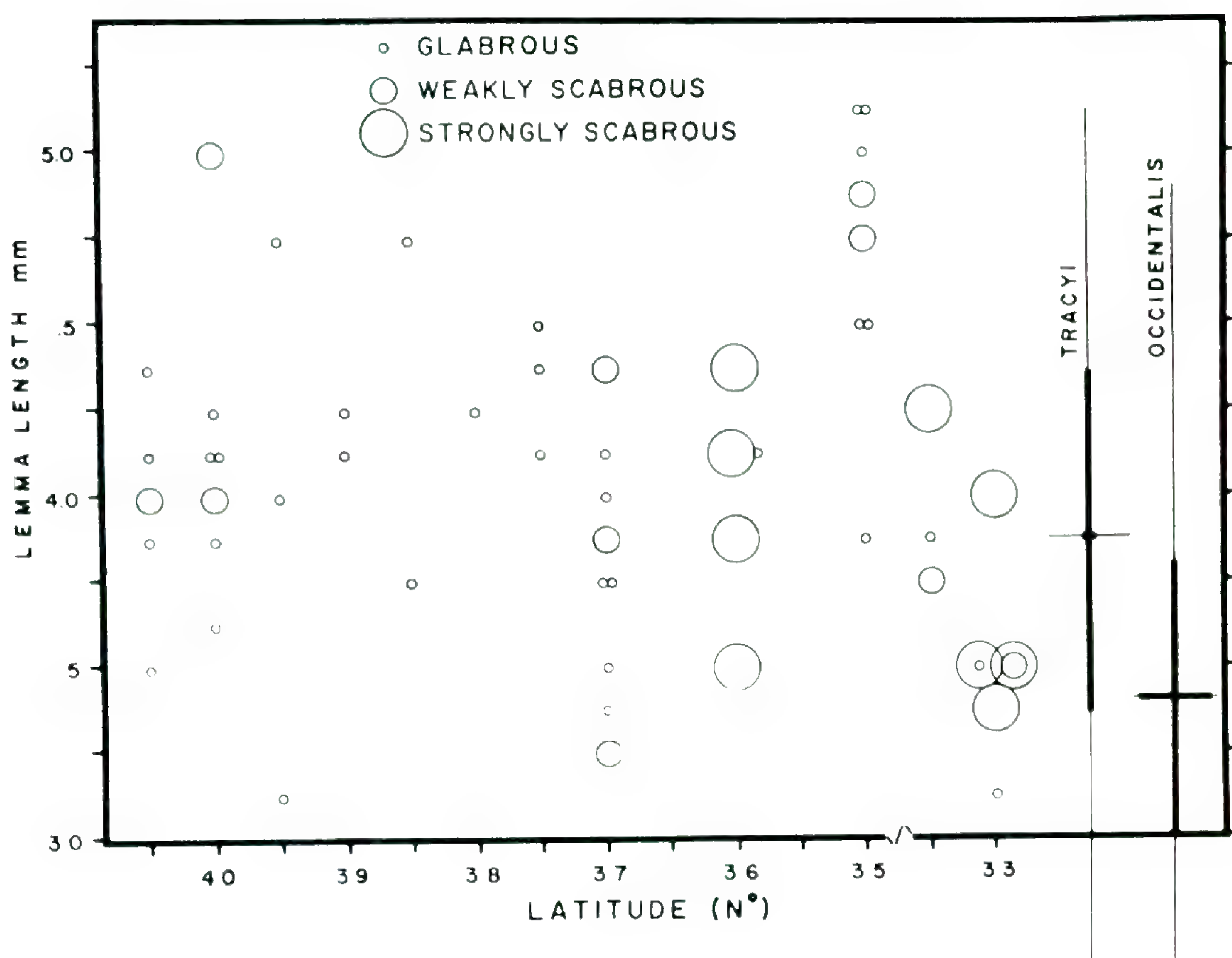


Figure 2. Plot of first lemma length and sheath scabrousness against latitude of occurrence for *Poa tracyi*. The figures at the right are mean, standard deviation, and range for first lemma lengths (vertical), and mean, and range of sheath scabrousness (horizontal). 40.5° N is approximately the northern border of Colorado: 37° N is approximately the Colorado-New Mexico border: 33.5° represents collections from the White Mts. N. M.: 33° represents collections from the Sacramento Mts. N. M.

are widely open at anthesis, with anthers mostly completely exerted and relatively large stigmas well exposed. 4) Differences in habitat tolerance: *Poa occidentalis* is mostly autogamous, and autogamous species are more often associated with early successional habitats than are xenogamous ones (Cruden 1977). Sixteen of 23 sites where we collected *P. occidentalis* were highly disturbed. This finding may be biased because disturbed areas by their nature are more easily accessible, but in contrast we only found *P. tracyi* in relatively undisturbed habitats (nine collections). Garden and field studies indicate that the differences between these taxa in the above characteristics are primarily genetic.

CHROMOSOME NUMBERS. *Poa tracyi* was consistently tetraploid ($2n = 28$) in five different plants from four different locations around Raton, New Mexico. No irregularities were found in meiosis. Indications are that *P. occidentalis* is diploid with $2n = 14$ (Hatch, 1980), and $n = \text{ca } 7$. However, a third plant (Soreng 123-b), $2n = \text{ca } 28$, may have been autotetraploid. It greatly exceeded the dimensions of neighboring plants being over

1 m tall and having leafblades more than 1 cm wide, but was similar in all other features. Although the chromosome preparation was poor there appeared to be many quadrivalents. Other species in this complex are *P. leptocoma* Trin. seven counts $2n = 42$, including two counts reported here (Cave, 1964; Fedorov, 1969; Moore, 1973 and 1977; Goldblatt, 1981), and *Poa reflexa* Vasey & Scribn. $2n = 28$, three new counts. The chromosomes of *P. curta sensu auct.* have not been counted. See Table 3 for collection citations.

STEPWISE DISCRIMINANT ANALYSIS. We used stepwise discriminant analysis (SDA) to test the distinctness of the two recognized taxa. The resultant SDA model (Table 4), based on 12 characters, correctly identified 276 out of 278 (99%) of the specimens. A "classification function" using these characters is presented in Table 4, and any future individual of *P. occidentalis* or *P. tracyi* may be identified with this. The most potent characters for discriminating between the taxa were the combination of percent sheath openness, palea length, and second glume length. The two misidentified specimens were members of sampled populations that otherwise showed no intermediacy between the taxa. These specimens are easily recognized as members of their respective taxa by characteristics (including anther length) not included in the SDA model.

A single linear canonical variable was calculated using the 12 SDA characters in a modified canonical variates analysis (coefficients are listed in Table 4). With this variable, each individual was projected onto a line where the group means were separated as far as possible. The resulting histogram (fig. 3) shows a clear distinction between the taxa. To examine the relative position of each population in this plot, values from individual populations were projected below their parent taxon (fig. 3). Assuming that the means of the herbarium samples were the best available estimates of the taxa means, we attempted to measure how far each population sample deviated from the mean of its taxon. By summing the scalar deviations of individuals above (sk_1) and below (sk_2) the taxon mean for each population, and then dividing the smaller deviation by the larger one,

$$\begin{aligned} sk_1 &= (X_i - \bar{X}) \text{ for } X_i < \bar{X} \\ sk_2 &= (X_i - \bar{X}) \text{ for } X_i > \bar{X} \end{aligned}$$

a skewness (sk) value was obtained that was between 1 (= centered on the mean) and 0 (all values on one side of the mean). In *P. tracyi*, the Sierra Blanca (White Mts.) sample ($sk = 0.06$), collected in close proximity to *P. occidentalis*, was the most strongly skewed from its species mean toward the other taxon. However, the Sacramento Mts. population of *P. occidentalis* is even more strongly skewed from its mean, away from *P. tracyi*. Although the positions of the other samples fluctuated about the taxon means when different character sets were used in this procedure, the above two populations retained their relative positions.

TABLE 3. Cytological vouchers.

POA OCCIDENTALIS: $2n = 14$, NEW MEXICO. Otero Co.: Cloudcroft, *Hatch* 2222 (TAES); $2n$ ca 28, 11 km NE of Cloudcroft, Dec 1978, *Soreng* 123-b; $n = 7$, Rio Arriba Co.: ca 33 km NW of Los Alamos, 15 Aug 1978, *Soreng & Hatch* 48.

POA TRACYI: $2n = 28$, NEW MEXICO. Colfax Co.: canyon N of Raton City Park, 11 Aug 1978, *Soreng & Hatch* 64, and 31 May 1979, *Soreng* 266; Raton Pass, on side on Bartlet Mesa, 1 June 1979, *Soreng* 267; ca 12 km NW of Raton, on the Raton Ranch, 3 Jun 1979, *Soreng* 274, and 7.5 km NW of Raton, *Soreng* 272.

POA REFLEXA: $2n = 28$, WYOMING. Sublette Co.: ca 50 km due N of Pinedale, Little Sheep Mt., 10 Aug 1980, *Soreng & Spellenberg* 1260. UTAH. Summit Co.: ca 80 km due E of Salt Lake City, Bald Mt., 11 Aug 1980, *Soreng & Spellenberg* 1336. NEW MEXICO. Taos Co.: Wheeler Peak, in La Cal Basin, 19 Aug 1980, *Soreng & Spellenberg* 1478.

POA LEPTOCOMA $2n = 42$, CANADA. Banff Natl. Park, E slopes of Mt. Peyto, 28 Jul 1980, *Soreng & Spellenberg* 1016. MONTANA. Glacier Natl. Park, 5 km NE of Logan Pass, 4 Aug 1980, *Soreng & Spellenberg* 1148.

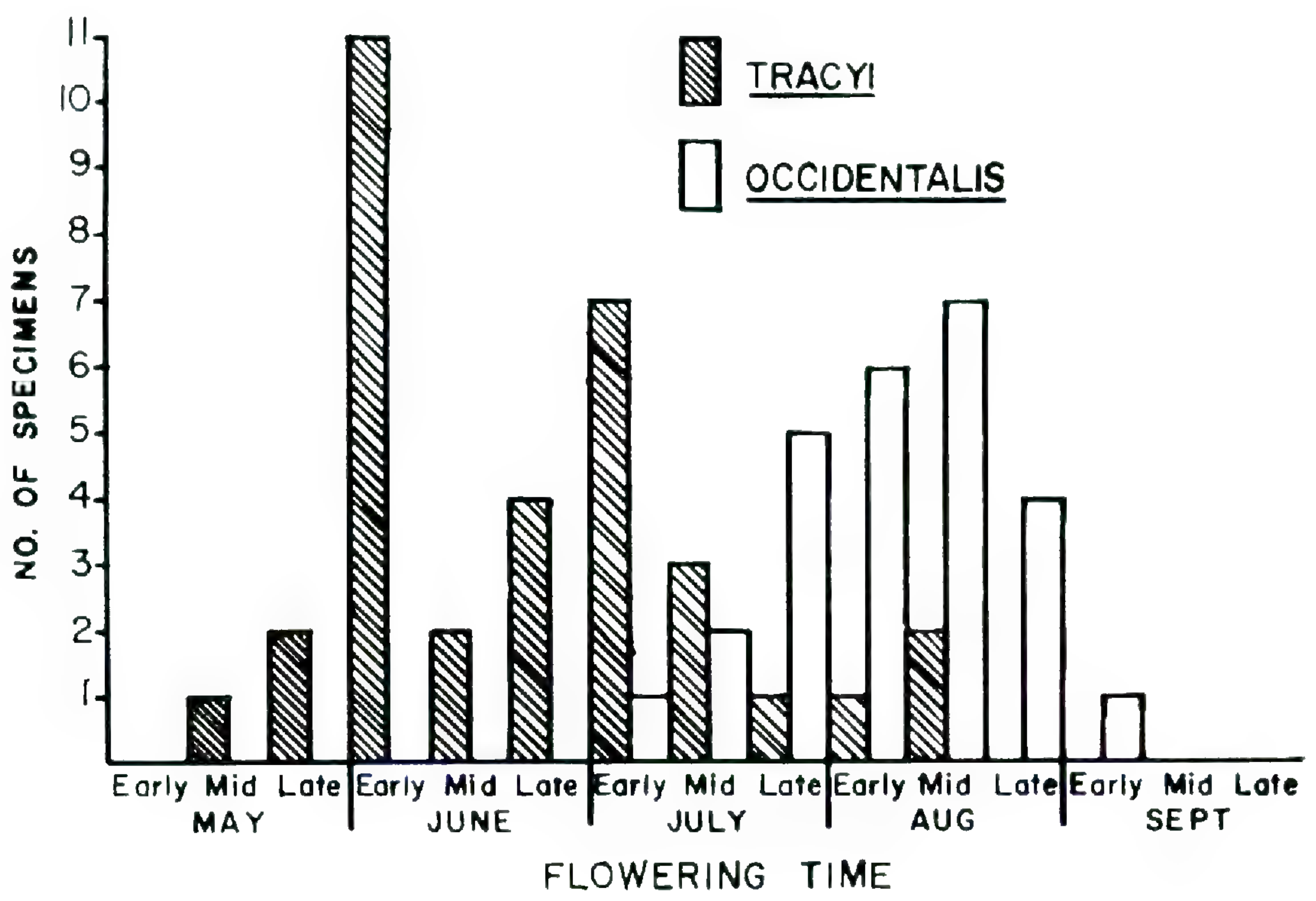


Figure 3. Histogram of the flowering times of *Poa tracyi* and *P. occidentalis*.

DISCUSSION

Comparison of *Poa occidentalis* and *P. tracyi* populations from the region of geographic overlap, and from herbarium specimens collected throughout their ranges, revealed two morphologically distinct groups. These groups in turn correspond to differences in phenology, certain aspects of breeding system, and possibly chromosome number. A stepwise discriminant analysis correctly identified 99% of the specimens tested. The additional character of anther length, or the presence of aborted anthers, was sufficient to distinguish all mature plants of these taxa.

The geographic distributions (fig. 2) of *P. occidentalis* and *P. tracyi* apparently do not overlap in Colorado. However, in New Mexico the taxa both occur in the San Juan, Sangre De Cristo, Sandia, White, and Sacramento mountains. The taxa are rarely sympatric, and remain morphologically distinct except in a few specimens from the Sangre De Cristo and Sacramento mountains. These specimens exhibit a mix of characters that normally distinguish only one or the other taxon. In addition, *P. tracyi* seems to have gained some characteristics of *P. occidentalis* in south central New Mexico.

Poa tracyi from the White and Sacramento mountains is morphologically highly variable. Specimens from there range from being nearly identical to type material of *P. tracyi* (from Raton area), to a few specimens that are difficult to distinguish from *P. occidentalis* except by anther length. One specimen (*Hitchcock* 13303; US) combines characters from both taxa and might best be considered a hybrid. In this region *P. tracyi* often has smaller spikelets, and very scabrous (occasionally pubescent) sheaths (six herbarium specimens and part of our Sierra Blanca population sample). Figure 4 illustrates this shift. In addition, in the Sangre De Cristo Mts. two collections of *P. tracyi* exhibit densely scabrous sheaths, one (*Standley* 4344; NMC, US) is possibly a hybrid. Other workers have noted the scabrouness of *P. tracyi* in the Sacramento Mts. Keck (unpublished) named a subspecies of *P. tracyi* based on sheath scabrousness in this region. A. S. Hitchcock, in his collection notes from there (August, 1915), correctly determined several specimens as *P. tracyi* and others as *P. occidentalis*. However, because his key character of sheath scabrosity breaks down there, he subsequently reclassified all his *P. tracyi* specimens from there as *P. occidentalis*. He later expressed his doubts about the distinctness of *P. tracyi* (*Hitchcock* 1935). However, in contrast to the variability of *P. tracyi*, *P. occidentalis* plants from the White and Sacramento mountains do not exhibit any tendency toward *P. tracyi*, and, as seen in the CVA histogram, may even deviate from the mean of *P. occidentalis* and away from *P. tracyi*. The simplest and most satisfactory explanation for these characters shifts in *P. tracyi* toward *P. occidentalis*, and the intermediacy seen between them appears to be introgression of *P. occidentalis* genes into *P. tracyi*.

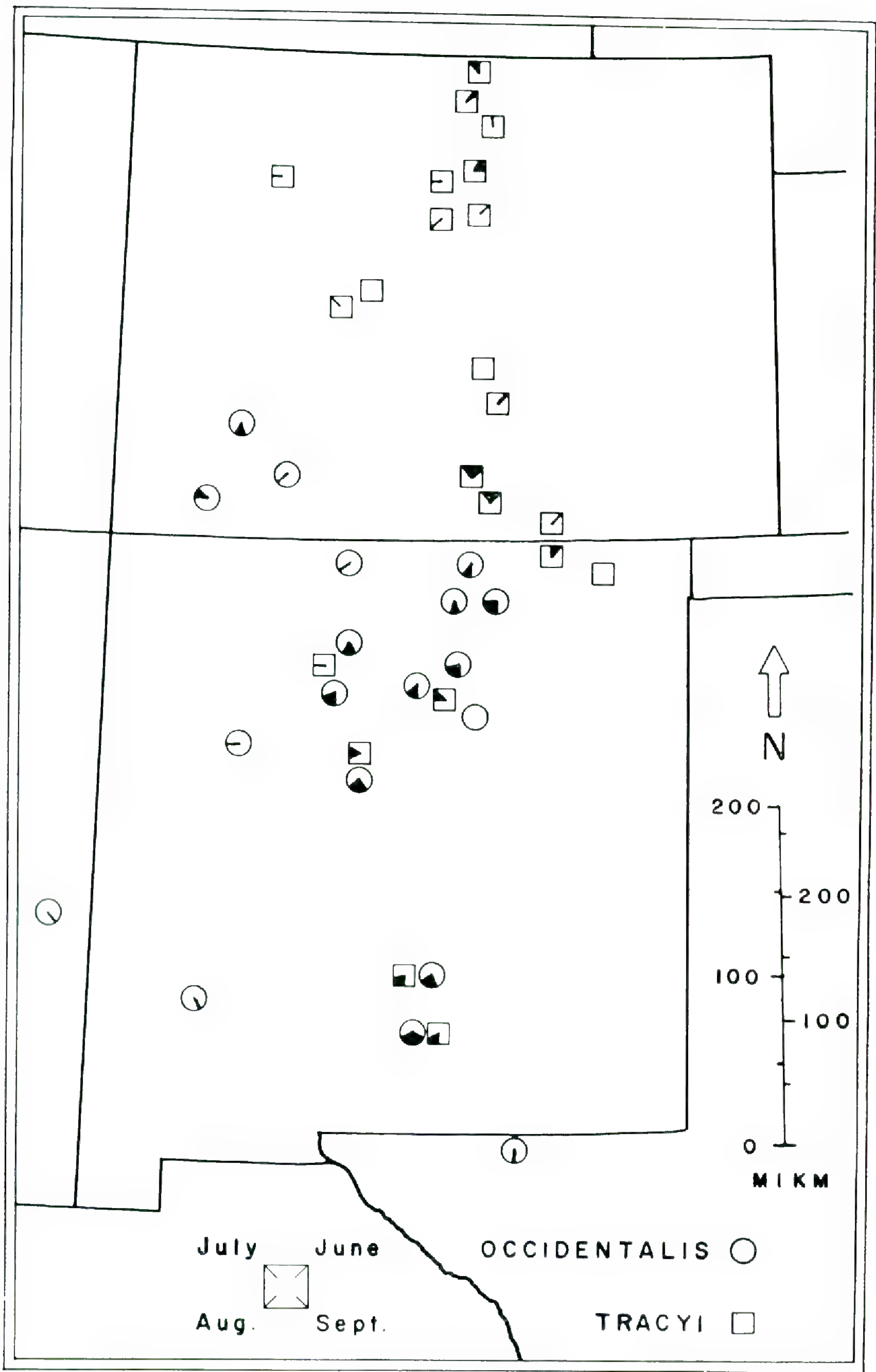


Figure 4. Geographical ranges and flowering time distributions through the ranges of *Poa tracyi* and *P. occidentalis*.

TABLE 4. SDA "classification function" and canonical variable coefficients.

Character	Classification function		Canonical Variable
	<i>P. tracyi</i>	<i>P. occidentalis</i>	
% Shcath closure	7.46839	4.08081	—0.67465
Palea length	1.88443	0.69584	—0.09730
Second glume length	—0.14802	0.53967	0.13696
Ligule length	—0.29283	0.03698	0.06568
Leafblade length	0.14021	0.08170	—0.01165
First lemma length	1.87414	1.08741	—0.15668
Lemma keel pubescence	8.98786	7.20448	—0.35516
Leafblade width	0.08673	—0.17177	—0.05148
Florets per spikelet	—4.48858	—2.66681	0.36281
Spikelet length	0.27300	0.15623	—0.02326
Spikelets per longest branch	0.08221	0.15108	0.01374
First glume length	0.31108	0.73634	0.08469
Constant	—91.51909	—58.86263	6.61007

CONCLUSIONS

A situation where two related taxa grow sympatrically without hybridizing is often considered the best possible evidence for distinct species (Mayr, 1969, p. 195). In *P. occidentalis* and *P. tracyi*, hints of introgression and the presence of putative hybrids from a few locations, indicate that a test of sympatry has failed occasionally. However, the distinctive biology of these taxa, and the ease of distinguishing the vast majority specimens, should outweigh possible limited hybridization. Furthermore, these taxa are diploid, or low polyploid, and are narrow in distribution. No diploid apomicts are known in the Poaceae. These points seem central to arguments delimiting species in *Poa* or any taxonomic group in which extensive hybridization and high polyploidy combine with apomixis to obscure specific differences. We doubt that *P. tracyi* has arisen as a direct autopolyploid from *P. occidentalis*. They are morphologically too distinct. In all probability, if *P. tracyi* is of hybrid origin, *P. occidentalis* may be one of its parents, or, if it is an autotetraploid, then it may have come from some common ancestor in the complex which has since disappeared. Hence, we must conclude that they are two species, and possibly better than most in *Poa*.

TAXONOMY

The species in the complex referred to earlier in this paper are all endemic to (except *P. leptocoma*) the central and southern Rocky Mountains, and the mountains of the Colorado Plateau. *Poa tracyi*, *P. occidentalis*, *P. reflexa*, *P. leptocoma*, and *P. curta* seem to form a closely related group. Known chromosome numbers were added to the key as an indication of the present level of knowledge.

KEY TO THE SPECIES

1. Anthers over 1.25 mm long, averaging more than 2 mm, (often aborted in *P. tracyi*); sheaths usually closed $\frac{1}{2}$ their length or more; plants often short-rhizomatous; usually few-flowered; rich soil in forest openings to subalpine habitats.
2. Lemmas prominently pubescent on the keel and marginal nerves, usually sparsely so between them, with long cobwebby hairs from the callus; ligules often puberulent abaxially; primarily in the front ranges of CO and NM; $2n = 28$ *P. tracyi*
2. Lemmas glabrous or nearly so, rarely sparsely puberulous, without long hairs on the callus; sheaths and ligules glabrous or nearly so; leaves broad and short; UT reaching sw. ID, and w. WY?..... *P. curta sensu auct.*
1. Anthers 1 mm long or less, flowers without abortive anthers; sheaths usually open $\frac{1}{2}$ their length or more; plants not at all rhizomatous (occasionally so in *P. leptocoma* and then of wet habitats); other characters variable.
3. Sheaths more or less densely retrorse-scabrous, infrequently glabrous; lemmas narrow, 2.6—4.9 mm long, with a scarious, white apex, this rarely at all bronze tinged; ligules mostly scabrous abaxially; culms to 110 cm tall; panicles (6—) 12—40 cm long; palea nerves glabrous, rarely sparsely ciliate; plants of mesic forested habitats, at elevations under 3500 m, from s. CO to s. NM, w. TX, and e.cent. AZ; $2n = 14$ (28)..... *P. occidentalis*
3. Sheaths sparsely retrorse-scabrous, to roughened or glabrous; lemmas broadly lanceolate and acute, or narrow and sharply acuminate, but if narrow then with the apical scarious portion bronze tinged; ligules smooth; palea nerves usually pubescent; plants usually of mesic, high mountain forests, or alpine habitats, rarely below 3300 m elevation if in the range of *P. occidentalis*.
4. Palea keels pilose-pubescent, (this sometimes obscure even under 25X); floral bracts broadly lanceolate, the glumes nearly equal; lemmas abundantly pubescent on the nerves, the intermediate nerves often distinct, sometimes pubescent; leaf blades usually short, broad, and strongly keeled; plants of mesic to wet habitats; in the Rocky Mts. from cent. Montana to n. NM, rare w. of UT; $2n = 28$ *P. reflexa*
4. Palea keels with antrorsely curved cilia or glabrous (under 25X); floral bracts long and narrow, sharply acuminate, the first glume often much shorter than the second and very narrow; lemmas often purplish, usually bronze-tinged at the apex, sparsely pubescent on the nerves, glabrous between them, the intermediate nerves usually obscure; leaf blades usually long, narrow, lax, and weakly keeled; plants of wet habitats; boreal, e. Russia, w. North America, to s.cent. NM; $2n = 42$ *P. leptocoma*

POA OCCIDENTALIS Vasey, Contr. U. S. Natl. Herb. 1:274. 1893.

TYPE: NEW MEXICO. Las Vegas, *G. R. Vasey s.n.*, in 1881. Described from the type specimen of *P. trivialis* L. var. *occidentalis* Vasey, 1885 a *nomem nudum*, Descr. Cat. Grasses U.S. 85. (HOLOTYPE: US 79610!).

Poa platyphylla Nash & Rydberg, Bull. Torrey Bot. Club. 28:266. 1901. Based on *P. occidentalis* Vasey, 1893.

Perennial, commonly blue-green and variously anthocyanic, non-rhizomatous, or rarely appearing so; culms often decumbent at the base, erect, to 110 cm tall, glabrous except for some retrorse scabrosity about the nodes; sheaths mostly longer than the internodes, rarely closed more than 50% of their length, strongly keeled, mostly strongly retrorsely scabrous,

rarely glabrous; ligules acute to acuminate, mostly entire, the apices often doubled back on themselves, usually with retrorse spicules on the abaxial surface, those of the upper leaves to 12.2 mm long, usually longer than the leaf width; blades mostly cauline, strongly keeled, flat to folded, prominently prow-tipped, the upper ones usually the longest, 4–18 cm long, 1.2–5.5 mm wide; panicle broadly pyramidal, (6-) 12–40 cm long, nodding with loosely ascending branches when young, erect with widely spreading branches when mature, the longest (3-) 5–23 cm long, with 8–120 spikelets; spikelets oblong, mostly crowded on the distal 1/2 of the branches, 3–8 mm long, with 1–7 florets, usually longer than the subtending pedicel, the rachilla often hidden by the florets; glumes nearly equal, the first 1-nerved, narrow, sharply acute, 2–3.2 mm long, the second 1–3-nerved, broader than the first, broadest at about the lower 1/3, gradually tapered to an acute tip, 2.5–4.2 mm long, nearly equaling the first lemma; lemmas usually green, strongly keeled, with scarious acutish tips that are white or rarely slightly bronzed when the body of the lemma is anthocyanic, the first 2.6–4.2 mm long, with sparse long cobwebby hairs from the callus, villous on the lower 1/2 of the keel, and lower 1/3 of the marginal nerves, glabrous to sparsely puberulent between them, the intermediate nerve usually distinct; paleas glabrous or rarely minutely scabrous on the nerves, 1/2 to nearly equaling the lemma in length; flowers perfect, the anthers 0.3–1.0 mm long.

Southern Rocky Mts., in the San Juan Mts. of SW Colorado, San Juan, Sangre De Cristo, Sandia, White and Sacramento mountains, Mt. Taylor, and the Black Range of New Mexico, White Mts. of Arizona, and the Guadalupe Mts. of Texas. Flowering from (early?) mid-July to September. On generally cool exposures in sparsely vegetated, disturbed and natural forest openings, elevation 2300 to 3500 m.

This species has been reported in floras of Alaska (Hulten, 1968), Canada (Scoggan, 1978), Oregon (Howell, 1903), and California (Abrams, 1940). Most of the reports of *P. occidentalis* occurring other than in the Southern Rocky Mtns. appear to stem from Vasey's unpublished *P. alsodes* Gray var. *occidentalis* which was realized later to be equivalent to *P. laxiflora* Buckl. However, before this realization, this variety was raised to a species as *P. occidentalis* Vasey & Scribn., published by Howell (loc. cit.), perpetuated by Abrams (loc. cit.), and said to be part of the Rocky Mtn. species as well. We examined most of the specimens identified as *P. occidentalis* from these ranges and they are referable to other species. The specimens cited by Scoggan (loc. cit.) as Canadian records could not be located, but are unlikely to be *P. occidentalis* Vasey.

Poa occidentalis was reported from Arizona (McLaughlin & Mason, 1977) based on *McLaughlin* 1217 a collection we believe represents *P. leptocoma*. A new collection (Apache Co.: White Mts. near Black River, N part of T5N, R27E, 6 Sep 1980, *Spellenberg & Soreng* 5248 (ARIZ, NMC)) is the first valid Arizona record of *P. occidentalis*. So far as we know the only record of

Poa occidentalis from Texas is unpublished, but the species has been found there (Culberson Co.: Guadalupe Mts. Nat. Park, elev. 7,700 ft, 14 Aug 1976, Burgess 4284 ARIZ).

Small specimens of *P. occidentalis* are often difficult to distinguish from *P. leptocoma* or *P. reflexa*, which share with it many of the characters that distinguish *P. occidentalis* from *P. tracyi*. These species are normally separated from *P. occidentalis* by their shorter panicles, palea nerve vestiture, lemma coloration (bronze-tinged lemma tips in *P. leptocoma*), and occurrence in more mesic habitats.

POA TRACYI Vasey, Bull. Torrey Bot. Club. 15:49. 1888.

TYPE: NEW MEXICO. Mesa side near Raton, alt. 7000–8000 ft, S. M. Tracy s.n., 1887. (LECTOTYPE: US 556764! (no one specimen in the series was singled out by Vasey); ISOTYPES: CAS!, GH!, NY!, RM!, TAES!, US!). (Jun 10 presumably the correct date of collection. Jul 20, and Jul 10 and 20 dates evidently copying errors, see Tracy, 1888).

Poa flexuosa Muhl. var. *occidentalis* Vasey, in Rothrock in Wheeler, U.S. Survey W. 100th Merid. Rpt. 6:290. 1878. TYPE: COLORADO. Twin Lakes, J. Wolf 1132, in 1873. (LECTOTYPE: US 79768! (no one specimen in the series singled out by Vasey); ISOTYPES: GH!, NY!)

Poa flexuosa Muhl. var. *robusta* Vasey, Contr. U.S. Natl. Herb. 1:271. 1893. TYPE: COLORADO. Bear Cr., latitude 40–41 N, alt. 8000–9000 ft., Vasey 673, in 1968 (Powell's expedition). (LECTOTYPE: US 79767! (no one specimen in the series singled out by Vasey); ISOTYPE: GH-).

Poa autumnalis Muhl. ex. Ell. var. *robusta* (Vasey) Beal, Grasses of North America. 2:534. 1886. Based on *P. flexuosa* var. *robusta* Vasey, 1893.

Poa nervosa (Hook) Vasey var. *tracyi* (Vasey) Beal, Grasses of North America. 2:538. 1896. Based on *P. tracyi* Vasey, 1893.

Poa occidentalis (Vasey) Rydberg, Mem. New York Bot. Gard. 1:50. 1900. Based on *P. flexuosa* var. *occidentalis* Vasey, 1878.

Poa lacustris Heller, Muhlenbergia. 6:12. 1910. Based on *P. flexuosa* var. *occidentis* Vasey, 1878.

Perennial, commonly blue-green and often variously anthocyanic, with or without short rhizomes; culms erect to 125 cm tall, glabrous or with some retrorse scabrosity about the nodes; sheaths mostly shorter than the internodes, rarely closed less than 50% of their length, strongly keeled, glabrous or less commonly strongly retrorsely scabrous, rarely retrorsely puberulent; ligules obtuse to acute, often apiculate, glabrous to strongly pubescent on the abaxial surface, ligules of the upper leaves to 4.5 mm long, usually shorter than the leaf width; blades mostly cauline, strongly keeled, flat, rarely folded except when young, prominently prow-tipped, the upper ones usually the longest, 6–18 cm long, 2–5.5 mm wide; panicle narrowly to broadly pyramidal, (8-) 13–29 cm long, erect, the lower internodes elongate, branches 1–5 per node, divergent when young, widely spreading to reflexed when mature, the longest 2.5–18 cm long, with 4–34 spikelets; spikelets mostly on the distal 1/2 of the branches, 3–8 mm long, with 1–8 florets, oblong, usually longer than the subtending pedicels, the rachilla usually

visible; glumes narrow, acute, the first usually less than $1/2$ the length of the first lemma, 1-nerved, 1.6–3.5 mm long, the second usually slightly shorter than the first lemma, 1–3-nerved, 2.2–4.4 mm long; lemmas green, strongly keeled, with whitish, scarious acute tips, the first 2.6–5 mm long, cobwebby hairs from the callus long and abundant or rarely nearly absent, usually with long, villous pubescence on the lower $3/4$ to $1/2$ of the keel, and $1/2$ to $1/3$ of the marginal nerves, usually puberulent between the nerves on the lower $1/2$, the intermediate nerves usually indistinct; paleas usually minutely scabrous on the nerves (pilose in one specimen), $2/3$ to nearly equaling the lemma in length; flowers perfect or imperfect, the two types usually mixed in the same inflorescence, sometimes all one or the other, the imperfect ones usually with aborted anther sacs present, the developed anthers 1.25–3 mm long.

Southern Rocky Mts., in the Park, Sawache, and Front ranges, Sangre De Cristo, and White mountains of Colorado, and in the San Juan, Sangre De Cristo, Sandia, White, and Sacramento mountains of New Mexico. Flowering from May to mid-July over most of its range, mid-July to mid-August in the White and Sacramento mountains of southern New Mexico. In humus rich soils, in thickets and forest openings, elevation 2000–3500 m.

Hitchcock (1935), Keck (1964), Beetle (1977), and Dorn (1977) have indicated that *P. tracyi*, or, *P. occidentalis* occurs in Wyoming. These distribution records appear to be based on three collections: *Buffum* 4907; *Buffum* 5111; and *Beetle* 1064. Although none of the above collections represent *P. tracyi*, or *P. occidentalis*, *P. tracyi* may yet be found there in the Big Snowy Range.

Poa tracyi has the strongly pubescent and webbed, narrow lemmas, long relatively broad blades, long panicles, stature, and tolerance of dry (relative to other members of this complex) habitats that are typical of *P. occidentalis*. However, *P. tracyi* has long anthers (when these are developed), short and often pubescent ligules, sheaths that are occasionally pubescent, and are closed most of their length, few flowered panicle branches, and occasional rhizomes, all characters that are typical of *P. nervosa* (Hook.) Vasey (especially in the *P. wheeleri* Vasey form). *Poa tracyi* it seems is intermediate between these species. *Poa tracyi* is perhaps more closely allied to the more western *P. curta sensu auct.* (there being some question about the identity of the type), a species similar in nearly all respects, but lacking floral or vegetative pubescence. *Poa tracyi* shows affinities to *P. reflexa* and *P. leptocoma*, and in some specimens is clearly distinguished from these only by its markedly longer anthers.

Keck suggested two subspecies (described and assigned types in an unpublished manuscript, and annotated specimens) of *P. tracyi*, neither of which is formally recognized here. His unpublished subsp. *durangoensis* appears to be conspecific with *P. aperta* Scribn. & Merr., a species quite distinct from *P. tracyi*. The unpublished subsp. *oterensis*, was segregated

on the basis of plants from the White and Sacramento mountains that had scabrous to pubescent sheaths. Because the presence of these characters appears to be highly variable in *P. tracyi* from this region, and many individuals from there are morphologically identical material to *P. tracyi* from Raton, New Mexico, the type locality, this segregation seems undesirable.

ACKNOWLEDGEMENTS

Authors wish to acknowledge the encouragement and help of Kelly Allred, the morphometric analyses suggestions by John Ludwig, and the guidance, comments and critical review of Richard Spellenberg. The efforts of the curators of herbaria (ARIZ, BH, BRY, CAN, CAS, CSU, CU, COLO, DAO, GH, MO, NMC, NY, POM, RM, RSA, TAES, UC, UNM, US, UT, UTC, and V) supplying loans for this project were sincerely appreciated.

REFERENCES

- ABRAMS, L. 1940. Illustrated flora of the Pacific States, vol. 1. Stanford Univ. Press.
- BARR, A. J., J. H. GOODNIGHT, J. P. SMALL and J. T. HELWIG. 1976. A user's guide to SAS 76. Raleigh, N. C.: SAS Institute.
- BEEBLE, A. A. 1977. Grasses of Wyoming. Univ. Agric. Exp. Sta. Res. J. 39R. 154 pp.
- CAVE, M. S. ed. 1964. Index to plant chromosome numbers for 1963. Chapel Hill: Univ. of North Carolina Press.
- CRUDEN, R. W. 1977. Pollen-ovule ratios: A conservative indicator of breeding systems in flowering plants. *Evolution*. 31:32-46.
- DIXON, W. J. 1975. Biomedical computer programs. Berkeley: Univ. California Press.
- DORN, R. D. 1977. Manual of the vascular plants of Wyoming, vol. 2. New York: Garland Productions Inc.
- FEDOROV, A. A. 1969. Chromosome numbers of flowering plants. Acad. Sci. U.S.S.R., Leningrad: Komarov Botanical Institute.
- GOLDBLATT, P. ed. 1981. Index to plant chromosome numbers 1975-1978. Missouri Bot. Gard.: Monogr. Syst. Bot. vol. 5.
- HARRINGTON, D. H. 1954. Manual of the plants of Colorado. Denver: Sage Books.
- HATCH, S. L. 1980. Chromosome numbers of some grasses from the southwestern United States and Mexico. *Southw. Naturalist* 25:278-280.
- HITCHCOCK, A. S. 1935. Manual of the grasses of the United States. U.S.D.A. Misc. Pub. 200. U.S. Govt. Print. Off.
- HOWELL, T. 1903. A flora of Northwest America, vol. 1, fascicle 7. Portland: Privately published.
- HULTEN, E. 1968. Flora of Alaska and neighboring territories. Stanford: Stanford Univ. Press.
- KECK, D. D. 1964. *Poa*. Pp. 17-21 in, A flora of Wyoming, part 3, by C. L. Porter. Univ. Agric. Exp. Sta. Bull. 418.
- McLAUGHLIN, S. and C. T. MASON Jr. 1977. Notes on new and rare Arizona plants. *J. Arizona Acad. Sci.* 12:203-204.
- MARSH, V. L. 1950. A taxonomic revision of the genus *Poa* of the United States and southern Canada. Ph.D. Thesis, Univ. Washington.
- MARTIN, W. C. and C. R. HUTCHINS. 1980. A flora of New Mexico, vol. 1. Germany: J. Cramer.
- MAYR, E. 1969. Principles of systematic zoology. New York: McGraw Hill.

- MOORE, R. J. ed. 1973. Index to plant chromosome numbers 1967-1971. *Regnum Veg.* 90:1-539.
- . 1977. Index to plant chromosome numbers for 1973/74. *Regnum Veg.* 96:1-257.
- RYDBERG, P. A. 1922. *Flora of the Rocky Mountains and adjacent plains*. New York: Hafner Publishing Co.
- SCOGGAN, H. J. 1978. The flora of Canada. *Natl. Mus. Natur. Sci. Pub. Bot.* No. 7(2):315.
- SNOW, R. 1963. Alcoholic hydrochloric acid-carmines as a stain for chromosomes in squash preparations. *Stain Technol.* 38:413.
- SORENG, R. J. 1980. A biosystematical comparison of *Poa occidentalis* Vasey and *Poa tracyi* Vasey. MS Thesis. New Mexico State Univ.
- TRACY, S. M. 1888. Report of an investigation of the grasses of the arid districts of Texas, New Mexico, Arizona, Nevada, and Utah, in 1887. Washington D. C.: U. S. Govt. Print. Off. Jan. 20.
- WEBER, W. A. and B. C. JOHNSTON. 1979. Natural history inventory of Colorado, part 1. 2nd. ed. Boulder: Univ. of Colorado Museum.
- WOOTON, E. O. and P. C. STANDLEY. 1913. The grasses and grass like plants of New Mexico. Las Cruces: New Mexico Coll. Agric. and Mech. Arts. Agric. Exp. Sta. Rio Grande Republican.

THE *DESMODIUM PANICULATUM* (L.) DC. (FABACEAE) COMPLEX REVISITED¹

DUANE ISELY

*Departments of Botany, and of Plant Pathology, Seed and Weed Science
Iowa State University, Ames, IA 50011*

ABSTRACT

This paper presents new information, derived from herbarium data, about the nature of variation in the *Desmodium paniculatum* complex. Three confluent species, *Desmodium paniculatum*, *D. perplexum*, and *D. glabellum*, are recognized, their discrimination, however, being subjective. Determination of the level of interbreeding in nature and of the effect of environment on the expression of phenotypes might lead to a clarification of interpretations.

The *Desmodium paniculatum* complex [*D. paniculatum* (L.) DC., *D. glabellum* (Michx.) DC., and *D. perplexum* Schubert], is widely distributed and common through most of the eastern and central United States. That it has frustrated several generations of botanists is evidenced by differences in published interpretations. It has seemed desirable, therefore, to reexamine the group preliminary to an account in the Vascular Flora of the Southeastern United States (University of North Carolina). This report presents documentation for treatment of the *Desmodium paniculatum* group in the Flora.

Nomenclature follows Schubert (1950a) who has examined types.

Because this paper refers repetitively to leaflet proportions, I use the abbreviation *r* (*ratio* of leaflet length to width) to designate leaflet proportions; i.e., leaflets 3–5 *r* means leaflets are 3–5 times as long as wide.

THE *Desmodium paniculatum* (L.) DC. COMPLEX

The members of this group, reasonably consistent in flower and fruit characters but highly variable in leaflet proportions and amount and nature of pubescence, are usually distinct from others of the series *Stipitata* Schubert (1950a). Collectively the *Desmodium paniculatum* complex may be described as follows:

Perennial herbs from a woody crown and tap root with usually clustered, erect, ascending or spreading stems 0.3–1.5 m long. Medial stems and leaf-stalks glabrous, or scantily or conspicuously uncinat- or pilose-pubescent, less frequently with a mixture of both kinds of hairs. Stipules subulate, caducous. Leaves usually well-petioled (exception *D. paniculatum* var. *epetiolatum* Schubert). Leaflets diverse in proportions, broadly ovate or

¹ Journal Paper No. 10960 of the Iowa Agriculture and Home Economics Experiment Station, Ames. Project No. 1983.

rhombic to narrowly oblong, ranging from ca 1.5–10 r , variable also in the amount and quality of pubescence: glabrous, scantily strigose with short, appressed hairs, or sparsely or (especially of lower surface) abundantly spreading-villous with longer hairs; uncinulate hairs present along veins of upper surface in some forms, infrequently so beneath. Inflorescence usually much branched. Bracts narrow, caducous. Pedicels usually 5–12 (–20) mm long. Flowers on dried materials ca 6–8 (–9) mm long. Loment stipe 1–3 (–4) mm, exserted beyond the calyx tube or not. Loments sinuate above, incised beneath, with (2–) 3–5 segments each (4–) 5–7 (–8) mm long, convex above, obtusely angled below.

INTERPRETATIONS OF THE *Desmodium paniculatum* COMPLEX

The following summarizes presentations of authors who have studied this group in some detail or (and) whose treatments are (or have been) widely used. Author's views are presented in key form, the differential characters being derived from their keys and descriptions or/and discussion. Direct quotations from the keys are so marked.

SMALL (1933). Four species as *Meibomia*.

1. Loment segments straight on the back, much longer than wide; standard 5–6 mm long; stems glabrous or sparingly pubescent..... *M. dillenii* (Darl.) Kuntze
1. Loment segments rounded or angled on the dorsal suture, various in length as follows; standard 4.5–7 mm long; stems variously pubescent.
 2. Blades of the leaflets broad, of an elliptic, ovate, or lanceolate type; standard 4.5–7 mm long; loment segments 3–5 mm wide; stem pubescence follows.
 3. Stem glabrous or nearly so; segments of the loment rounded on the ventral side; standard 4.5–5.5 mm long; loment segments 4–5 mm wide. *M. paniculata* (L.) Kuntze
 3. Stem puberulent or finely pubescent; segments of the loment prominently angled on the ventral side; standard 6–7 mm long; loment segments 3–4 mm wide. *M. pubens* (T. & G.) Young
 2. Blades of the leaflets narrow, of a linear or linear-lanceolate type; standard 4–6 mm long; loment segments 4–5 mm wide; stems puberulent or nearly glabrous. *M. chapmanii* (Britt.) Small

Meibomia glabella (Michx.) Kuntze, another species listed by Small, is neither the *Desmodium glabellum* (Michx.) DC. of Schubert (1950b) or Wilbur (1963, 1964) nor a member of this group.

Although some herbaria yet contain specimens named according to Small's criteria, his views have been followed by no other author.

SCHUBERT (1950a). Three species.

This author, providing the first critical evaluation of the group, reduced *Desmodium paniculatum* var. *angustifolium* T. & G. and *Meibomia paniculata* var. *chapmanii* Britton (and their nomenclatural synonyms) to synonymy under her var. *typicum* and described *D. paniculatum* var. *epetiolatum*, a form with obsolescent petioles.

The traditional *Desmodium dillenii* Darl., which was not compared with *D. paniculatum*, was felt to be composed of two elements as follows (abstracted from text).

1. Petioles long; leaflets acute, thinner with little or only obscure reticulation, more abundantly pilose. *D. perplexum* Schubert
1. Petioles shorter; leaflets obtuse, usually retuse [presumably thick], with prominent venation, less conspicuously pilose. *D. glabellum* (Michx.) DC.

In this listing, *D. perplexum* partially replaces the traditional *D. dillenii* that was discarded as a *nomen confusum*.

SCHUBERT (1950b). Three species.

Schubert's (1950a) views were expanded and modified in her treatment of *Desmodium* in the eighth edition of the Gray's Manual.

1. Plants with coriaceous and conspicuously reticulate leaflets that are usually appressed-pilose on both surfaces, usually uncinulate pubescent above; stems uncinulate-puberulent and usually at least sparsely spreading-pilose; terminal leaflet broadly obtuse and slightly emarginate. *D. glabellum* (Michx.) DC.
1. Plants with thinner leaflets that are less conspicuously reticulate, are inconspicuously to evidently pilose, and usually lack uncinulate pubescence; stems glabrous, puberulent or uncinulate-puberulent; terminal leaflet usually acute, not emarginate.
 2. "Leaflets thin with appressed, sparse to moderate pubescence; terminal leaflets mostly lanceolate and twice to many times as long as broad; stems sparsely if at all pilose, usually uncinulate-puberulent." *D. paniculatum* (L.) DC.
 3. Petioles ca 1.5–5 cm long; loment segments angled; distribution of species. var. *typicum* Schubert
 3. Petioles lacking or short; loment segments rounded; mostly Coastal Plain. var. *epetiolatum* Schubert
 2. "Leaflets mostly thicker, abundantly to densely appressed-pilose on both surfaces; terminal leaflet usually elliptic or rhombic to ovate and about twice as long (sometimes longer) as broad; stems, petioles and usually rachis of inflorescence moderately to very densely spreading-pilose as well as uncinulate-puberulent." *D. perplexum* Schubert

GLEASON (1952). Two species.

1. Leaflets linear to oblong-lanceolate, commonly 3–5 (–10) times as long as wide, usually with some hairs scattered on lower surface of leaflets; flowers usually 6–8 mm long; loment joints 3–6, 5–7.5 mm long. *D. paniculatum* (L.) DC.
1. Leaflets oblong-ovate, commonly 1.5–3 times as long as wide, sparsely pubescent above, densely to sparsely pubescent beneath; flowers 7–10 mm long; loment joints 2–4, 5–9 mm long. *D. dillenii* Darl.

Under *Desmodium paniculatum*, Gleason noted the variation in leaflet shape; from plants with leaflets "a third to even two-fifths as wide as long . . . there is every gradation in leaflet width to plants with linear leaflets only a fifth to a tenth as wide as long." Of pubescence, he says "there is every gradation from glabrous plants to others softly pubescent on the leaves and more or less villous in the inflorescence." He considered that "those with broader leaves cannot be distinguished from *D. dillenii*."

GLEASON AND CRONQUIST (1963). Two species.

This treatment, derivative from Gleason (1962), includes the brief statement that "the broader-leaved forms [of *D. paniculatum*] seem to grade into No. 19" [*D. dillenii*]. Both of these Gleason treatments also include a *D. glabellum* (Michx.) DC., but that name is used for a species [*D. humifusum* (Muhl.) Beck] that is not a member of this complex.

ISELY (1953). One species.

Isely tabulated leaflet proportions and amount of leaflet pubescence for 200 specimens from throughout the range of the complex. His data, presented in graphs and scatter diagrams, confirmed Gleason's empirical statements ("every gradation") and suggested that variation represents a quantitative continuum. There was, however, reasonable correlation between leaflet portions and abundance of leaflet pubescence; i.e., plants with broad leaflets were usually more pubescent than those with narrow leaflets. Thus an idealized *Desmodium paniculatum* and *D. dillenii* might be recognized on the basis of an arbitrary definition of the pubescence/leaflet proportions relationship. Isely believed, however, that the complex probably represented a single polymorphic entity in which there was partial genetic linkage between leaflet form and amount of pubescence. His view was strengthened by previous field experience in which he had observed nearly all types through the total range of the complex. He had noted also that single populations might include several phenotypes. Consequently he designated the groups as one species, *D. paniculatum*, containing several intergrading forms of which these two were most clearly distinguishable:

1. Terminal leaflets usually 3–8 times longer than wide; leaflet pubescence moderate to scant, commonly appressed; stems glabrate or, if sparsely pubescent, most of hairs uncinatae. var. *paniculatum*
1. Terminal leaflets usually 1.5–3 times as long as wide; lower surface of leaflets pubescent, predominantly with spreading trichomes; stems pubescent, usually with a mixture of uncinatae and spreading hairs. var. *dillenii* (Darl.) Isely

ISELY (1955). One species.

A brief reiteration of the 1953 views.

STEYERMARK (1963). One species.

Working in Missouri, Steyermark followed Isely almost exactly. As with Gleason and Isely, he was unable to recognize Schubert's *Desmodium glabellum*. "It has not been found possible to arrange the Missouri material formerly identified as *D. dillenii* into the categories *D. perplexum* and *D. glabellum* as distinguished by Dr. Schubert."

WILBUR (1963). One species.

Wilbur, treating the legumes of North Carolina, however, came to a different conclusion. Although (p. 169) he qualified his treatment of "the

puzzling range of variation exhibited within the complex" as "tentative," he asserted "there appears to be but little difficulty in separating" the glabrous or moderately appressed-pubescent plants with narrow leaflets (i.e., *D. paniculatum*), from the others. Concerning the others, he said, "Those specimens with broader leaflets and almost always much more pubescent are quite satisfactorily separated into two piles but not by using most of the characters indicated by Schubert . . ." He then used quality of stem pubescence to achieve a segregation of *D. perplexum* and *D. glabellum* and posited three species as follows.

1. "Leaflets narrow, usually 3–8 times longer than broad; plants glabrous to sparsely appressed short-pubescent..... *D. paniculatum* (L.) DC.
1. "Leaflets wide, usually less than 3-times longer than broad;" plants pubescent, often conspicuously so.
 2. "Pubescence of medial portion of stem densely uncinulate-puberulent and very sparingly if at all supplied with pilose trichomes." *D. glabellum* (Michx.) DC.
 2. "Pubescence of medial portion of stem moderately to densely pilose.".....
.....*D. perplexum* Schubert

WILBUR (1968). Three species.

Wilbur's treatment in the *Manual of the vascular flora of the Carolinas* reiterated the preceding stated interpretation.

PROCEDURE

Working with 650 specimens (holdings of FLAS, ISU and NCU, number reduced to 607 for tabulation because of excessive within-county redundancy) and using features conveniently discernible to conventional binocular magnification, as Wilbur, I attempted to put material into "piles." After discarding several arrangements, specimens were arranged in a scheme whose irregularity stems from the fact that it seemed "to work" better than any other. It may be summarized as follows:

GROUP 1. The *paniculatum* types. Leaflets 3–8 (–10) *r*. Plants of glabrate aspect. Pubescence on leaflets usually scant, of short, appressed hairs. Medial stems glabrate or with a trace of appressed or uncinuate hairs. In some plants the leaflets are graduated upwards on stem; i.e., they are broader below than above. If upper ones exceeded 4 *r*, the specimens were placed in this category.

To separate group 1 from groups 2–5 when leaflet proportions were in the overlap zone ($+ 3 r$), specimens were placed in the pubescence group they best fitted.

- 1a. The typical *paniculatum* type. Leaflet pubescence scant, of short, appressed hairs. Stems glabrate, Leaflets 3–8 (–10) *r*.
- 1b. Leaflet pubescence more abundant, that on lower surfaces of longer, somewhat spreading hairs. Stems with or without scant pubescence. Leaflets mostly 3–5 *r*.

Because of variation in stem pubescence, this subgroup was subsequently

subdivided on the basis of stem pubescence. 1b(a), 1b(c), 1b(d), 1b(e), the stem pubescence characters being those of 1a, and of 1c, 1d, and 1e, following.

1c, 1d, 1e, 1f. All of these with the typical scant (i.e., 1a) leaflet pubescence but medial portion of stem slightly or evidently pubescent as listed following. Leaf portions various.

1c. Some *perplexum*-type pilose pubescence (see Group 2).

1d. Some *glabellum*-type uncinata pubescence (see Group 3).

1e. Mixture of *perplexum* and *glabellum* pubescence types or pubescence of intermediate form.

1f. The *epetiolatum*-type; petioles 2–10 mm; upper leaves subsessile.

GROUPS 2-5. The *perplexum*-*glabellum*, etc. types. Leaflets 1.5–3 (-4) *r*. Plants usually (not so in group 5) of pubescent aspect. Pubescence of both medial stems and/or leaflets usually evident, of longer and/or uncinata hairs, and not appressed.

GROUP 2. The *perplexum* type. Medial stems and leafstalks with pilose pubescence.

2a. Pubescence evident and conspicuous.

2b. Pubescence scant, sometimes almost entirely restricted to leafstalks.

GROUP 3. The *glabellum* type. Medial stems and leafstalks with uncinata pubescence, sometimes a few pilose hairs also on leafstalks and pulvini.

3a. Pubescence dense and conspicuous.

3b. Pubescence scant.

GROUP 4. The *perplexum*-*glabellum* type. Medial stems with both pilose and uncinata hairs; or pubescence of intermediate form, i.e. the hairs intermediate in length and vaguely hooked at the tip.

4a. Lower surface of leaflets with evident or conspicuous pubescence.

4b. Lower surface of leaflets with reduced or negligible pubescence.

The abundance of stem pubescence among plants in group 4 is usually scant. Note that the secondary classification in this group and the following one (no. 5) is on the abundance of leaf pubescence rather than stem pubescence as in groups 2 and 3.

GROUP 5. Types with obsolescent stem pubescence but broad (1.5/3 *r*) leaflets.

5a. Lower surface of leaflets with evident pubescence.

5b. Lower surface of leaflets with reduced pubescence.

After specimens were assigned to these categories, the number in each category and their distribution by states were recorded.

OBSERVATIONS

Ranges given in regional and state floras indicated that the members of the *Desmodium paniculatum* complex, however classified, are approximately

sympatric, and this is confirmed in this sampling except that *D. perplexum* does not extend into Florida. The range is southern Maine (slightly into Ontario), west to Iowa, south to eastern Texas, and eastward to Florida. The sampling is neither sufficiently complete nor representative to justify a statement that the ranges are precisely the same, to analyze the extent to which the proportions of the different types may differ in various parts of the range, or to assert that all the smaller segregate categories may be found throughout this large area. It does indicate, however, that none except *Desmodium paniculatum* var. *epetiolatum* have a specific geographic orientation; the others are distributed throughout most of the range.

A tabulation of the groups 1–5 described in the *Procedures* section follows, and the data are summarized in Figure 1. Notation of range observed among these specimens follows the sequence: northeast, northwest, southwest, southeast. The number of specimens for each group and subordinate group provides an estimate of their abundance. The accompanying text summarizes the major features of this classification.

THE *D. PANICULATUM* TYPES. GROUP 1.

Vermont, Iowa, Louisiana, Florida. 375 specimens: 1a, 305; 1b(a), 25; 1b(c), 1; 1b(d), 12; 1b(e), 1; 1c, 2; 1d, 19; 1e, 3; 1f, 7 (Figure 1, Group

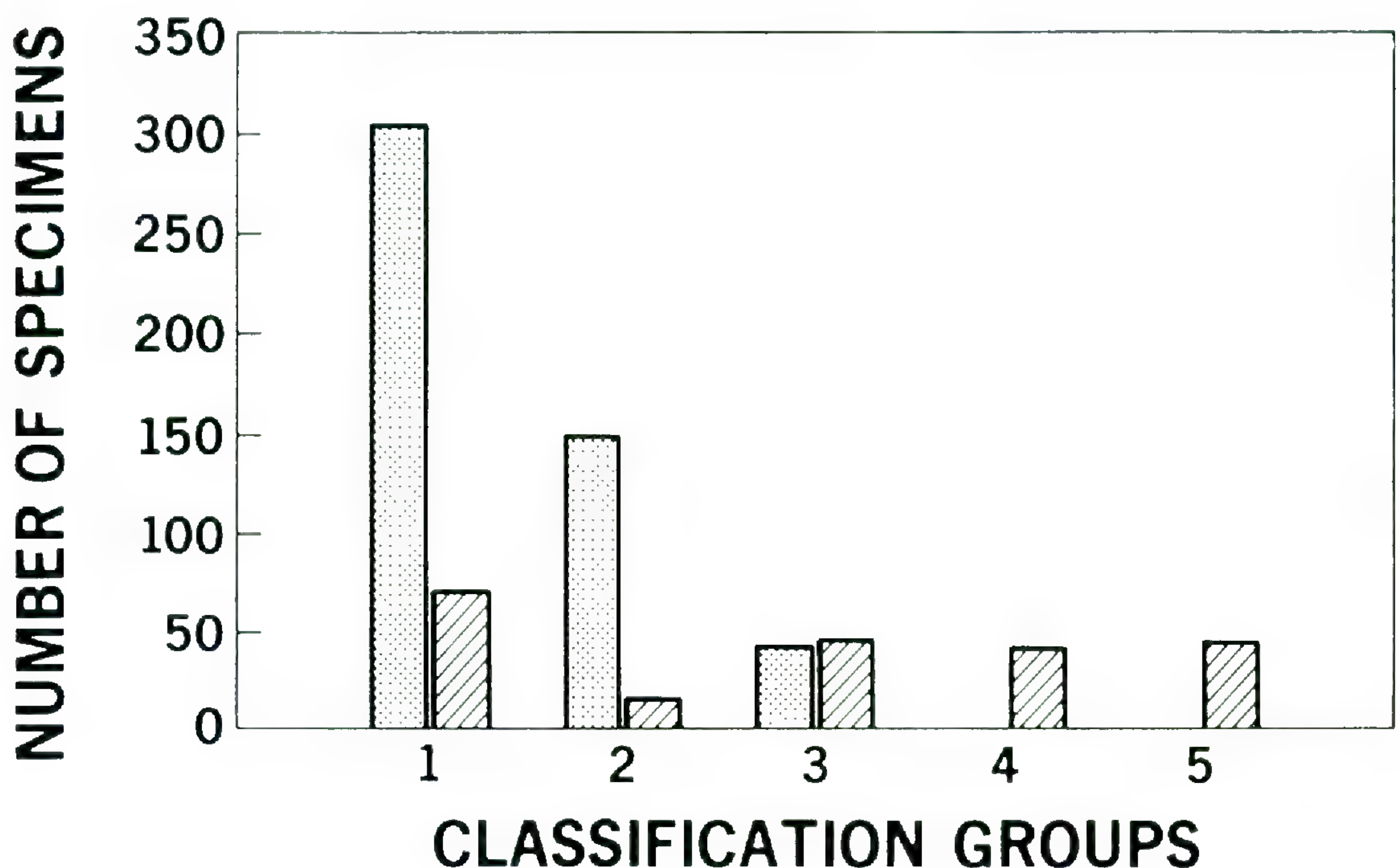


Figure 1. Comparison of number of specimens of three taxa of the *Desmodium paniculatum* complex. Data listed under Observations. Stippled bars: Specimens "typical" and identity definitive. Oblique-line bars: Specimens "atypical," identity ambiguous or equivocal. 1. *Desmodium paniculatum*. 2. *D. perplexum*. 3. *D. glabellum*. 4. Intermediate types, *D. perplexum-glabellum*. 5. Recondite types with broad leaflet and glabrous or glabrate stems.

1). (In Figure 1, the "atypical" group represents the total of the several categories, 1b-1f, listed here).

What this tabulation tells us is that most of the abundant material fits the ideal *Desmodium paniculatum* formula (narrow leaflets, scant pubescence; hairs short and appressed), but that an appreciable number of plants have longer, spreading leaflet pubescence or/and *glabellum* type uncinuate stem pubescence (but almost none with *perplexum* stem pubescence). The aberrant pubescence forms are distributed through the leaf-proportion range.

Botanists have been unanimous in determining plants with narrower leaflets as *D. paniculatum* regardless of pubescence. Among those with broader leaflets (3-5 *r*), determinations as *D. paniculatum* or *D. glabellum/perplexum* become inconsistent depending on the relative weight that the worker places upon leaflet proportions and nature of pubescence. If leaflet proportions are entirely disregarded, group 5 (broad leaflets, reduced or nil pubescence) would mostly be referred to typical glabrate *paniculatum*, 1a. Indeed from 1a one wavers at the border line, not only of group 5 and of 2b and 3b (these are the *perplexum* and *glabellum* types with scant pubescence) but also of groups 1b and 1d. Subjective judgment is such that passes that I have made through this material brought some repositioning each time.

The nature of Group 1f (Schubert's *D. paniculatum* var. *epetiolatum*) is different from any of the preceding. Not only does it stand out on a morphological basis (much shortened petioles and some rounding of loment segments) but it has a specific eastern Coastal Plain range from southeastern Virginia to northern South Carolina. This statement is based on specimens I have seen plus those cited by Schubert (1950a, excluding her anomalous Texas reference). A hybrid combination between *D. paniculatum* and *D. ciliare* might be visualized, but these species are sympatric over a much more extensive range.

THE *D. PERPLEXUM* TYPES. GROUP 2.

Maine, Iowa, Louisiana, Georgia. 166 specimens. 2a, 149; 2b, 17. (Figure 1, Group 2).

These have broad leaflets and characteristic pilose pubescence on the stems and petioles that, however, is variable in amount. Most of this variation is included in group 2a in which the pubescence is conspicuous or at least evident. Most of the 2b group, on the other hand, has almost no stem pubescence but it is evident on the petioles where it is possibly more persistent than on the stems.

Leaflet blade pubescence is most abundant on the under-surface and, though diverse in amount (almost velvety to scant), is of much longer hairs than of the *D. paniculatum* group, and these hairs are characteristically spreading, incumbent or slightly ascending. The upper leaf surface usually ranges from scantily pubescent with similar (though usually shorter) hairs to glabrate.

Some specimens have tiny uncinulate hairs along the major veins of the upper surface.

Between the *D. paniculatum* and *D. perplexum* types there is an obvious correlation of three characters—leaflet proportions, presence or absence of stem pubescence and the nature of leaflet pubescence. But there are a sufficient number of failures of such correlation and of intermediates to render sharp discrimination impossible.

THE *D. GLABELLUM* TYPES. GROUP 3.

Connecticut, Missouri, Texas, Florida. 89 specimens. 3a, 43; 3b, 46. (Figure 1, Group 3).

My annotation essentially agrees with that of Wilbur (NCU specimens) except that I have divided *D. glabellum* into two groups and have relegated some of his *D. glabellum* to groups 4 and 5.

D. glabellum, as *D. perplexum*, has broad leaflets (usually 2–3 *r* but sometimes to 4 *r*; or to 5 *r*, if one regards pubescence as more important than leaflet proportions). Typical *D. glabellum* (3a) with a dense, close covering of uncinulate hairs on the stem is unmistakable. But it fades into the equally abundant scantily or barely pubescent plants (3b) that merge with *paniculatum* 1d forms that have broad leaflets and with the glabrate types of group 5. It includes both plants with some pilose pubescence on the pulvini and those with negligible pubescence on the stems but distinct uncinulate pubescence on the petioles.

Leaflet pubescence of *D. glabellum* is similar to that of *D. perplexum* and, though likewise variable in abundance, perhaps averages less in amount. This tends, on the average, to give the leaflets a more reticulate aspect. Uncinulate hairs along the veins on the upper surface are common, though not invariable, and such pubescence is sometimes present also along veins on lower leaflet surfaces.

THE *D. PERPLEXUM-GLABELLUM* TYPES. GROUP 4.

Pennsylvania, Iowa, Louisiana, Florida. 42 specimens. 4a, 32; 4b, 10. (Figure 1, Group 4).

Here is a heterogeneous catchall for seeming intermediates, usually with relatively inconspicuous stem and leafstalk pubescence, in which the *Desmodium glabellum* influence perhaps predominates. It may include a mixture of a few hairs of the two contrasting kinds, or the hairs themselves may be intermediate in form, as described in the foregoing description of classification.

Wilbur, as to annotations, placed these plants with the species (*Desmodium perplexum* or *D. glabellum*) that he believed they most closely resembled. They indeed merge not only with the scantily pubescent forms of the named species but also with those of group 5 following. The subclassification (4a and 4b) indicates that the kinds with reasonably evident leaflet pubescence are most abundant.

THE *D. PANICULATUM* COMPLEX. Ambiguous specimens with glabrous (glabrate?) stems and broad leaflets. Group 5.

Maine, Iowa, Louisiana, Florida. 45 specimens. 5a, 20; 5b, 25. (Figure 1, Group 5).

Leaflet pubescence may be spreading or (5b, reduced leaflet pubescence) short and appressed as in the *paniculatum* type, but tends to be uncinulate along the veins. A correlation between pubescence abundance on stems and leaves is indicated by the fact that 5b constitutes proportionately a larger subsegment than does 4b of group 4 among which there was at least some pubescence on the stems.

The group 5 plants seemingly represent a mixture of reduced-pubescence forms related to group categories 2, 3, 4, but some may be essentially *paniculatum* (group 1) with broader leaflets than conventionally attributed to that type. Plants with conspicuous pubescence on the leaves (5a) or/and those with a few pilose hairs on leafstalks or pulvini perhaps can be associated with group 2 (*perplexum*); those with uncinulate hairs along the leaflet veins suggest group 3 (*glabellum*), and those with but short, strigose hairs on the leaflets, resemble broad-leaved forms of *paniculatum* and are but subjectively separated from the several categories of that group. Perhaps some of these latter kinds might represent hybrids with *Desmodium laevigatum* (Nutt.) DC.

OTHER "MIXTURE" DATA.

Field observations easily reveal different phenotypes of the *Desmodium paniculatum* complex growing in association. Contrasting plants may occur in adjacent colonies that within themselves are relatively uniform, or a single colony may include several kinds of plants. Unfortunately, I have never attempted to document these observations except that I once gathered six leaves from representative plants in a single colony (Powell Co, KY: Isely 7422, ISC). Three are of the *paniculatum* type, 1a, with leaflet proportions 5.3, 5.5 and 3.5 *r*; one is *perplexum*, 2a, 2.3 *r*; two are *perplexum*, 2b, both 1.7 *r*. Also, from Marion Co, TN, Isely and Wemple 9409, 9411 and 9412 (ISC) represent three phenotypes from three contiguous colonies. These are *D. paniculatum* (1a) and *D. glabellum* (3a and 3b).

I have scanned ISC for specimens containing two stems not organically connected and hence possibly from different plants in a colony. Among about 15, I found sheets with different phenotypes from Kentucky, Arkansas, Georgia, Alabama and Florida.

Leaflet proportions on a single plant are usually reasonably consistent but in some the leaflets are graduated narrower upwards on the stem. Among a stem cluster from a single crown, one can sometimes discern slightly different leaflet proportions between stems.

EXOMORPHIC VARIATION NOT TABULATED.

The flowers seem to be identical except for some variation in color and size, those of *Desmodium perplexum* perhaps averaging somewhat the largest. But they have not been studied in detail.

Pedicle length is variable, (3-) 5–12 (-20) mm. Those of ideal *Desmodium paniculatum* not uncommonly exceed 10 mm and appear filamentous. Those of *D. perplexum*, on the other hand, are usually less than 10 mm in length and appear stouter. Those of *D. glabellum* are diverse.

Loment stipe ranges in length from 1 mm, and hidden by the calyx remnants, to 3.5 (-5) mm and strongly exerted. The proximal 1–2 mm of the first segment is sometimes abruptly narrowed, making the stipe appear longer. Most commonly, *Desmodium paniculatum* and especially *D. glabellum* have plainly exerted stipes while those of *D. perplexum* are usually little evident above the calyx. But the difference is not diagnostic.

Length of the loment segments falls within the range (3.5-) 5–7 (-8.5) mm. *Desmodium perplexum* on the average has the larger segment but there is no diagnostic distinction. There seems to be no differential trend in the number of segments nor in the variation in their shape among the species.

As a means of checking these generalized statements, I measured pedicle, stipe and loment segment length on 15 specimens each of "typical" *D. paniculatum*, *perplexum*, and *glabellum*, (groups 1a, 2a, and 3a) randomly chosen from throughout their range. Summarized data follows:

		PEDICLE LENGTH	STIPE LENGTH	LOMENT SEGMENT LENGTH
<i>Paniculatum</i>	Range	4.5–13 mm	1.2–3 mm	3.5–7 mm
	Mean	7.9 mm	2 mm	5.5 mm
<i>Perplexum</i>	Range	3–7 mm	1–3.1 mm	4–8.5 mm
	Mean	5.7 mm	1.6 mm	6.1 mm
<i>Glabellum</i>	Range	5.2–13 mm	1.5–5 mm	4–7.6 mm
	Mean	7.7 mm	3 mm	5.7 mm

These limited data of course have no statistical significance. But they roughly confirm the ad hoc observations of the preceding paragraph. The differences are not diagnostic and disappear among the various intermediate forms.

HABITAT

Neither my field observations over a period of some years nor herbarium data reveal significant differences in habitat.

HYBRIDIZATION (INTERMEDIACY) WITH OTHER SPECIES?

Nearly all phenotype combinations encountered can be referred to variation from within the gene pool(s) of this group. Thus, ostensibly, hybridization between members of this complex and other species is infrequent. This

statement must be qualified by the fact that putative hybrids are more difficult to detect than in *Lespedeza* where strongly contrasting characters of different species are easily evident. A few 3b and 5a plants with quite long loment stipes and pedicels might represent hybrids with *Desmodium laevigatum* (Nutt.) DC. From another direction, certain specimens in these same groups possibly suggest *D. fernaldii* Schubert. I have seen one plant that is seemingly intermediate between *D. paniculatum* and *D. ciliare* (Muhl.) DC. *D. paniculatum* var. *epetiolatum* Schubert is conceivably of hybrid origin.

DISCUSSION

Although prior authors, as reviewed, have presented differing taxonomic treatments, most have referred to intermediacy between taxa and have recognized inadequacies in present understanding of the complex. These observations then primarily detail what is believed, and provide no new shining light.

Among available treatments, I view Wilbur's (1963, 1968) as most satisfactory. The germ for discernment, however, perhaps derives from Schubert (1950a, 1950b) even though several of us (Isely, 1953; Wilbur, 1963; Steyermark, 1963) have stated inability to use Schubert's differential characters for *Desmodium glabellum*. Evidently she had a "feel" for that taxon because those of her annotations I have seen closely match both Wilbur's and mine. The idealized concepts of Wilbur and Schubert are, indeed, validated by the majority of specimens, which fall into discernible categories. The problem then is that the identification of too many others is ambiguous.

Wilbur's annotations reveal that he placed ambivalent material with the species it most closely resembles following subjective but rather consistent criteria. For example, in the differentiation of *Desmodium paniculatum* from the two kinds with usually broader leaflets, he, as others preceding him, identified those with narrow leaflets, ca 4–8 *r*, as *D. paniculatum* regardless of the nature of the pubescence. However, at about 4 *r*, he abandoned leaf proportions as a diagnostic character and made determinations on the basis of pubescence. The distinction between *D. glabellum* and *D. perplexum*, as indicated in his key, is based on stem pubescence, but only a minority of his *D. glabellum* have stems that are "densely uncinulate puberulent." Instead, it includes the entire range of variation in the amount of such pubescence, those with scant pubescence being excluded only if the pilose pubescence of *D. perplexum* is also present and more conspicuous. The key statement for *D. perplexum* allows for variation in pubescence ("stem moderately to densely pilose") but actual separation not only allows a wider range of stem pilosity but includes some plants in which the stems are essentially glabrate, the pubescence being limited almost entirely to the leafstalks. His assignment of plants with intermediate or both kinds of pubescence is based on

judgment as to which kind is predominant. Wilbur then has followed a fairly consistent course in identification, but it does not entirely accord with the statements in his key, nor with a concept that the species are as clearly defined as he (1963) states.

The preceding paragraphs imply that observed variation is genetic, but this may not be entirely true. The weight of environmental factors, however, is unknown. It is possible (or probable) that some plants with especially thin, large and broad leaflets that also have reduced pubescence are shade forms in which the conventional distinctions between the species are enfeebled or obliterated. If, however, three species can be distinguished only by features whose diagnostic value is vitiated by environmental influences, this in itself possibly questions the validity of the taxa.

Another factor leading to ambiguity of classification may be the condition of the specimens. Pubescence in *Desmodium perplexum* and *D. glabellum*, particularly the former, is probably partially lost as stems age. I tried to nullify this consideration by also checking leafstalks where pubescence seems to be more persistent, but this may result in confusion with forms in which the pubescence clearly is mostly limited to the leafstalk. One can also examine the upper (i.e., younger) foliose portions of the stem, but care has to be used to avoid proximation with the inflorescence pubescence that is uncinata in all species.

I think it is fairly clear that all of us who have studied this complex are somewhat groping in the dark. We have been limited to subjective interpretations based primarily on herbaria holdings. None of us know what is going on biologically. Perhaps the present state of knowledge allows three overlapping hypotheses as follows:

(1) There are three closely related but genetically reasonably discrete taxa whose range of exomorphic variation overlaps with respect to the characters treated as diagnostic. We do not yet know how to best interpret their differentiation and relationship among patterns of variation in the "diagnostic" features. If other discriminating characters exist they have yet to be discerned.

(2) There were originally three taxa, differing in leaflet shape and pubescence, that owed their identity to some kind of isolation, presumably ecological. *Desmodium*, except for those of the *D. glutinosum* group, are sun-loving plants. With destruction of the forests and the increased prevalence of open habitats, this isolation was eliminated, and no doubt the plants are much more common than they were 300 years ago. The consequent invasion of abundant hybrid habitats has spawned a maze of intermediates perhaps in somewhat the same way as is believed to have happened in *Crataegus*.

(3) The entire complex is a single polymorphic species containing within its gene pool conspicuous variation in the amount and nature of the pubescence and in leaflet proportions. The variation observed is that of a com-

monly cross-pollinated heterozygous species in which there is sufficient linkage between leaflet proportions and pubescence that some genotypes are much more prevalent than others.

None of these hypotheses are entirely satisfactory on the basis of present information. Among them, hesitantly, I favor two or three because the plants grow in association in similar habitats and have similar if not identical ranges, and because I find the unifying characters more significant than the several patterns of variation. For example, most species of *Desmodium* exhibit differences in their fruits. Those in this group, however, are fundamentally consistent in aspect and usually easily recognized. True, there are some differences in the range of variation of stipe length and loment-segment size, between the putative taxa, but these are not of diagnostic nature. Thus, whether differences among populations, or of individuals, are of leaflet proportions, of nature of pubescence, or of loment characters, the species are separated only by features that are highly variable. Possibly the very conspicuous variation in leaflet proportions has maintained the traditional view that there must be several species.

Among these alternatives, one might favor number three (that the taxa were originally more discrete) were there some basis for postulating the nature of their original isolation.

A conventional apologia to a report of this kind is a statement that detailed biosystematic (and perhaps chemical and taximetric) studies of these species are needed and must be conducted before the group can be understood. No doubt, such investigations would be welcome, but vast accumulation of data does not necessarily lead to congruence in classification. Relatively elementary information that could respond to the following questions might, however, lead to some clarification.

(1) Are these species capable of crossing? If so, how frequent is this in nature? (This information could be obtained by using routine methodology of plant breeding or biosystematics).

(2) To what extent does environment, particularly incidence of light, affect expression of genotypes?

(3) How does the expression of pubescence and its senescence change as the plants grow and mature?

CLASSIFICATION

Presently for floristic purposes, I propose a procedure similar to that employed in *Flora Europaea* (Tutin et al., 1964, 1968). "In certain cases where it is difficult to distinguish between a number of closely similar species, an ad hoc 'group' has been made, and these groups, not the individual species, are keyed out in the main species-key." Thus this assembly could be called the *Desmodium paniculatum* (L.) DC. (complex) under which the component members are keyed as follows:

1. Leaflets (2.5-) 3-8 (-10) *r*; leaflet pubescence usually scant, of short, appressed hairs (infrequently more conspicuous and of somewhat longer spreading hairs), uncommonly including some uncinulate pubescence; medial stem glabrous or glabrate, or if with a few hairs, these usually minute and uncinulate (rarely a few pilose hairs present on leafstalks and pulvini). *D. paniculatum* (L.) DC.
1. Leaflets 1.2-3 (-4) *r*; leaflet pubescence usually evident and of longer spreading or somewhat incumbent hairs, commonly including some uncinulate pubescence, primarily along nerves on upper surfaces of leaflets; medial stems usually with evident pubescence of either pilose or uncinulate hairs or both.
 2. Stem and leafstalk pubescence of pilose hairs, these abundant and conspicuous or scanty and limited primarily to leafstalks; some uncinulate pubescence occasionally also present on stems and along veins on upper surface of leaflets. *D. perplexum* Schubert
 2. Stem and leafstalk pubescence of uncinulate hairs that form a dense or scant covering; a few pilose hairs sometimes also present on pulvini, rarely also on leafstalk; uncinulate pubescence commonly present along veins on upper surface of leaflets. *D. glabellum* (Michx.) DC.

The above key, though arbitrary, more completely partitions variation than do those of Wilbur (1963, 1968). If the member within the group is evident, identification can be extended to it. On the other hand, if identity is ambiguous, the worker can determine a plant as a member of the *Desmodium paniculatum* (L.) DC. complex and leave the matter at that. If more precision is desired, the code identification supplied in this classification could be added (specimens I have seen are so marked). By so proceeding, some consistency of determination, though at varying levels of diagnosis, might be obtained.

The species names, synonymy as to authors cited in previous discussion, and the Isely code listings follow.

DESMODIUM PANICULATUM (L.) DC.

Meibomia paniculata (L.) Kuntze; *M. paniculata* var. *chapmanii* Britton and nomenclatural synonyms; *D. paniculatum* var. *pubens* T. & G. and nomenclatural synonyms; *D. paniculatum* var. *angustifolium* T. & G. and nomenclatural synonyms; *D. paniculatum* var. *epetiolatum* Schubert; *Desmodium paniculatum* var. *typicum* Schubert. 1a, 1b, 1f; 1c, 1d, 1e in part; some approaching 2b, 3b, 4b, and 5b.

Schubert (1950a, p. 153) examined the syntypic cited specimens of *Desmodium paniculatum* var. *pubens* T. & G. and felt they represented "the more pubescent extreme of *D. paniculatum* var. *typicum*," and I have listed that name accordingly. Small (1933), however, treated plants of this type as a separate species, *Meibomia pubens* (T. & G.) Young. By description ("stem puberulent; leaves oblong-lanceolate, rather rigid, pubescent, especially beneath") they would probably fall in one of the several intermediate groups listed herein.

Varieties *chapmanii* and *angustifolium* both represent phases of *D. paniculatum* with narrow leaflets. Var. *typicum* includes the whole scope of idealized *D. paniculatum*. Var. *epetiolatum* is a regional form that probably deserves nomenclatural listing.

DESMODIUM GLABELLUM (Michx.) DC. but not of Gleason (1952) nor Gleason and Cronquist (1963); nor *Meibomia glabella* (Michx.) Kuntze of Small (1933).

Meibomia paniculata var. *obtusa* (Desv.) Schindl. *D. dillenii* Darl. and nomenclatural synonyms of authors in part. 3a, 3b; 4a and 4b in part; some approaching 1a, 1b, 1d, 1e.

Reference of *Meibomia paniculata* var. *obtusa* to *Desmodium glabellum* is based on Schubert's (1950a, p. 154) statement about it. As previously noted, the *Desmodium* (or *Meibomia*) *glabellum* of literature refers to two different species.

DESMODIUM PERPLEXUM Schubert

Desmodium dillenii Darl. and nomenclatural synonyms of authors in large part; *Desmodium paniculatum* var. *pubens* T. & G. and nomenclatural synonyms of authors in part. 2a, 2b; 4a and 4b in part; some approaching 1a, 1c, 1e, 5a.

Prior to 1950, most *Desmodium perplexum* and *D. glabellum* passed under the classic *D. dillenii* Darl. Schubert (1950a) found four specimens in the Darlington herbarium to be non-congruent, and a Dillenian plate cited unidentifiable. Consequently she abandoned this name as a *nomen confusum*.

ACKNOWLEDGEMENTS

I extend thanks to Drs. Bernice Schubert and Robert L. Wilbur who reviewed this manuscript, but this does not imply that they agree with the conclusions. Rebecca R. Johnson provided technical and clerical help. The loan of specimens from the herbaria of the University of North Carolina (NCU) and the University of Florida (FLAS) is appreciated. Research supported in part by NSF Grant DEB-8103505.

REFERENCES

- GLEASON, H. A. 1952. *Desmodium*, pp. 424–432. In: The new Britton and Brown illustrated flora of the northern United States and Canada. Van Nostrand, Princeton.
- and A. CRONQUIST. 1963. *Desmodium*, pp. 400–413. In: Manual of vascular plants of northeastern United States and adjacent Canada. The New York Botanical Garden, New York.
- ISELY, D. 1953. *Desmodium paniculatum* (L.) DC. and *D. viridiflorum* (L.) DC. Amer. Midl. Naturalist 49: 920–933. 1953.
- . 1955. The Leguminosae of the north-central United States. II. Hedysaraceae. Iowa State Coll. J. Sci. 30: 33–118.
- SCHUBERT, B. C. 1950a. *Desmodium*: preliminary studies—III. Rhodora 52: 135–155.
- . 1950b. *Desmodium*, pp. 915–923. In: M. L. Fernald. Gray's manual of botany, ed. 8. American Book, New York.
- SMALL, J. K. 1933. *Meibomia*, pp. 531–535. In: Manual of the southeastern flora. Publ. by author, New York.
- STEYERMARK, J. A. 1963. *Desmodium*, pp. 912–925. In: Flora of Missouri. Iowa State University Press, Ames, IA.

- TUTIN, T. G. et. al (eds.) 1964, 1968. *Flora Europaea*. 2 vol. Cambridge University Press, Cambridge, Great Britain.
- WILBUR, R. L. 1963. *Desmodium*, pp. 134–171. *In*: The leguminous plants of North Carolina. North Carolina Agric. Exp. Sta. Techn. Bull. 168.
- . 1968. *Desmodium*, pp. 604–613. *In*: A. E. Radford, H. E. Ahles, and C. R. Bell. *Manual of the vascular flora of the Carolinas*. University of North Carolina Press, Chapel Hill.

TAXONOMY OF *ERIGERON CONCINNUS* (ASTERACEAE) AND ITS SEPARATION FROM *E. PUMILUS*

GUY L. NESOM

Department of Biology, Memphis State University, Memphis, TN 38152

ABSTRACT

Erigeron concinnus appears to be a distinct species rather than a subspecies of *E. pumilus*. Detailed study of *E. concinnus* and *E. pumilus* subsp. *intermedius* in Nevada and adjacent areas shows them to be allopatric and morphologically non-intergrading. Further, previous literature has reported that *E. concinnus* does not intergrade with *E. pumilus* subsp. *pumilus* where their ranges approach each other in Colorado. A new combination is proposed: *E. concinnus* var. *subglaber* (Cronq.) Nesom.

Cronquist (1947) regarded *Erigeron pumilus* Nutt. as comprising three subspecies, each with a fairly well-defined geographic range (Fig. 1) but with substantial amounts of morphological intergradation among them. Besides the recognition of subsp. *intermedius* Cronq., of particular significance was his lowering of the rank of *E. concinnus* (Hook. & Arn.) Torr. & Gray to subsp. *concinnoides* Cronq. "Subspecies *typicus* [*pumilus*] becomes difficult to separate from subspecies *intermedius* in western Montana. Subspecies *intermedius*, in turn, passes readily into subspecies *concinnoides* where their ranges overlap. Subspecies *concinnoides* and subspecies *typicus* [*pumilus*], however, behave almost if not quite as distinct species, where their ranges meet."

Cronquist's judgement has been accepted by a number of contemporary taxonomists who have dealt with these taxa; exceptions are Kearney and Peebles (1969), followed by Lehr (1978) in Arizona, and Welsh and Moore (1973) in Utah, who referred to the population systems in their areas as *E. concinnus* rather than *E. pumilus* subsp. *concinnoides*. These latter authors, however, presented no rationale for their difference of opinion. In connection with contributing to the developing Flora of Nevada by John Kartesz, I have had an opportunity to study Nevada *Erigeron* and to evaluate an important part of the basis of Cronquist's taxonomy with regard to *E. pumilus* subsp. *intermedius* and subsp. *concinnoides*, each of which occurs over a large portion of the state.

METHODS

The larger-scale distribution map (Fig. 1) was constructed using information from Cronquist (1947), Kearney and Peebles (1969), Martin and

Hutchins (1981), Harrington (1964), Barkley (1977), and Munz (1959), as well as from label data of specimens studied. Kearney and Peebles (1969) reported *Erigeron concinnus* from Cochise and Pima counties, Arizona, but I have not confirmed these records. Morphological data and distributions of the taxa in Nevada (Fig. 2) were derived from a study of 160 collections. Plants from southwestern Wyoming, southern Idaho, and northern Utah also were studied in detail, as were geographic samples representing the remainder of the range of *E. concinnus*.

RESULTS AND DISCUSSION

The results are partly summarized in Fig. 2. In Nevada no intermediates were found and the two taxa appear to be completely allopatric (or at least parapatric). These remarkable geographic and morphologic discontinuities also are found in California and south-central Idaho (Fig. 1), where both

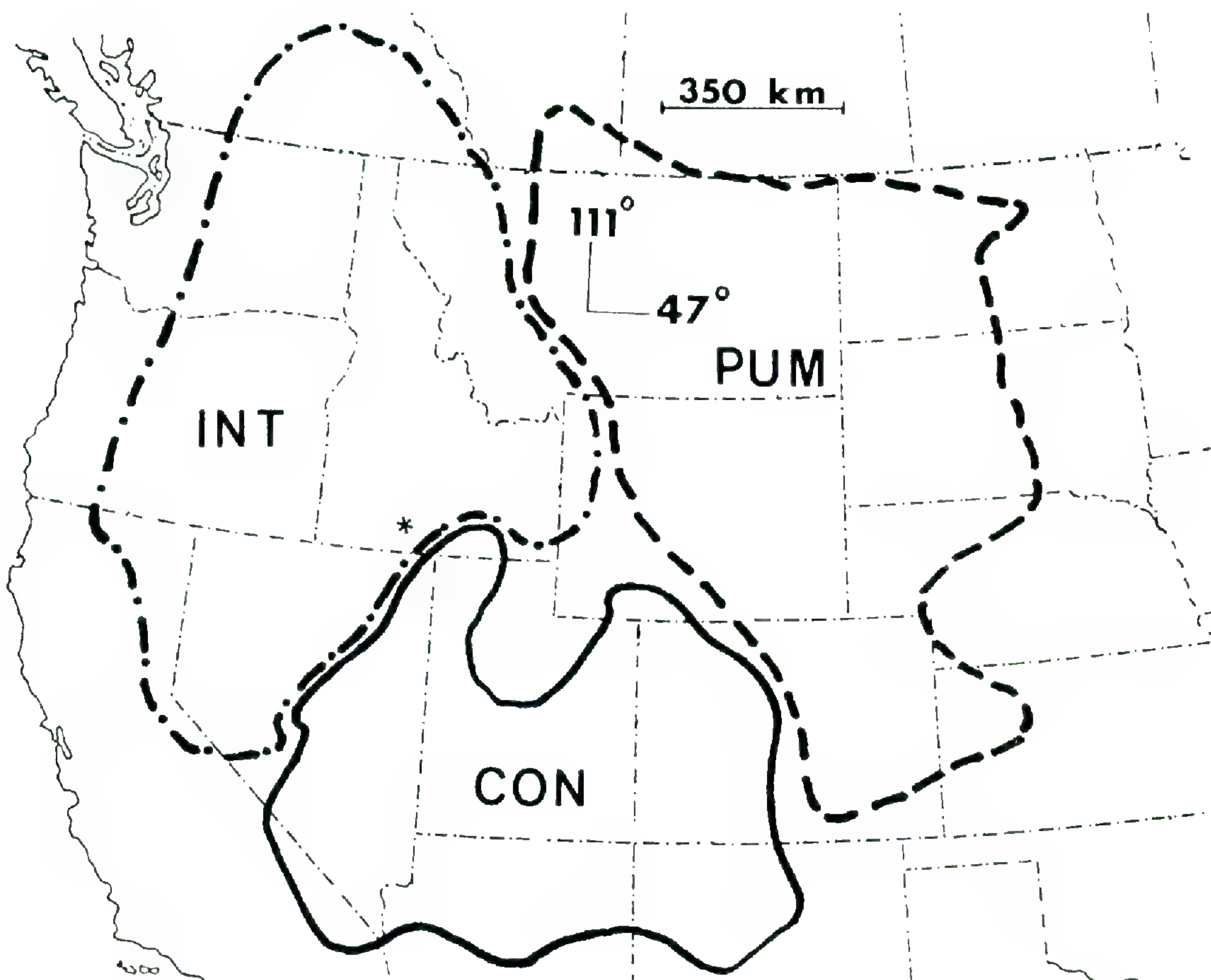


Fig. 1. Generalized distributions of *Erigeron concinnus* (CON), *E. pumilus* subsp. *pumilus* (PUM), and *E. pumilus* subsp. *intermedius* (INT). A collection of *E. pumilus* subsp. *pumilus* also has been reported (Cronquist, 1947) from northeastern Arizona. The asterisk in southern Idaho represents the approximate, probable collection locality of the type of *E. concinnus* (see discussion under Taxonomy).

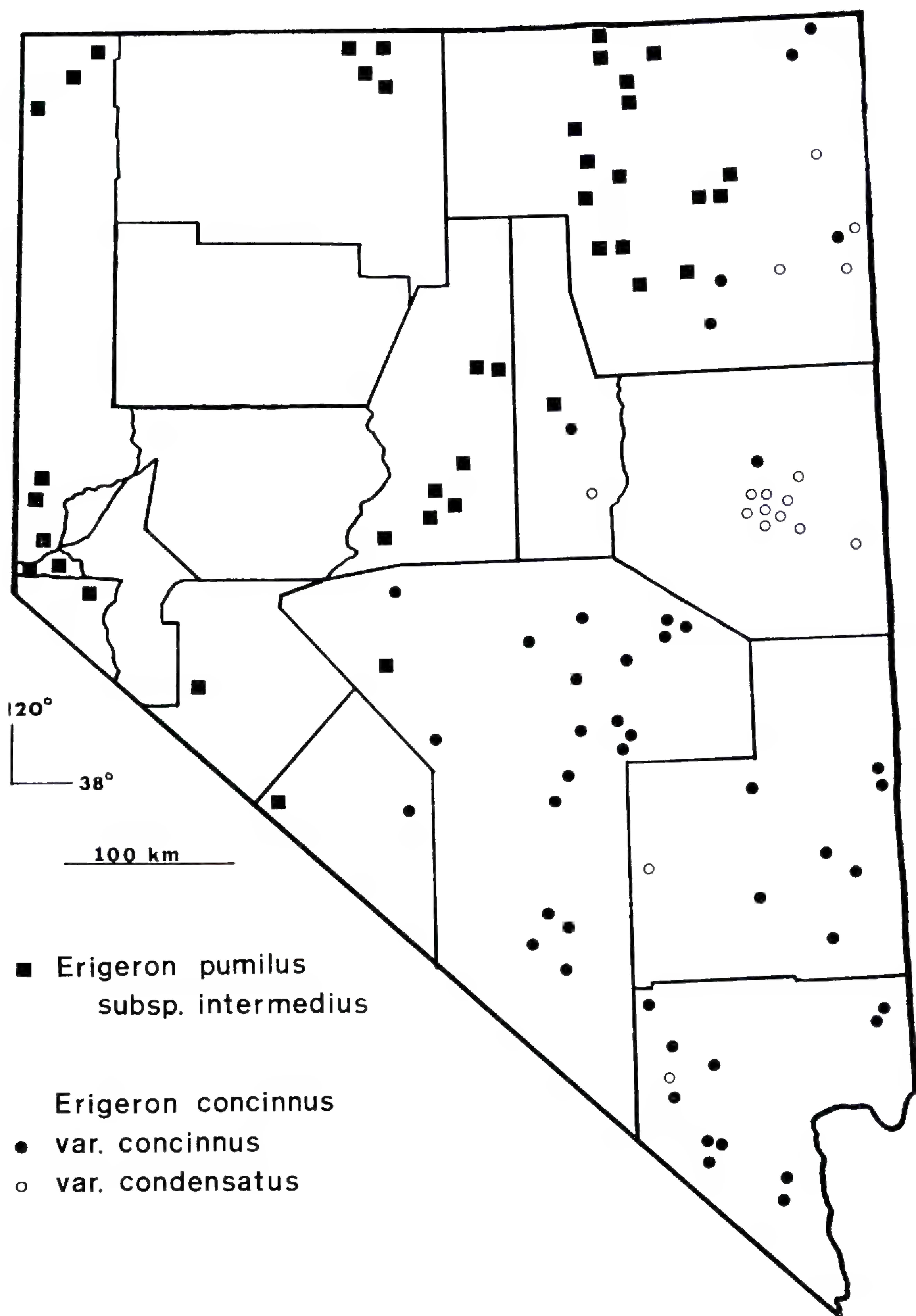


Fig. 2. Distribution of *Erigeron concinnus* and *E. pumilus* subsp. *intermedius* in Nevada.

taxa occur. Because this area includes nearly all of that where *E. pumilus* subsp. *intermedius* and subsp. *concinnoideus* might have been expected by Cronquist to "overlap", this critically weakens the force of his argument for including *E. concinnus* within *E. pumilus*, and I believe they are best regarded as distinct species.

The northern-most known populations of *Erigeron concinnus* have been collected in Cassia and Power counties, Idaho, where they are distinct from *E. pumilus* subsp. *intermedius* (but see comment under *E. concinnus* in the Taxonomy section). One collection from Cassia Co. (Holmgren 3506—UTC) appears to be somewhat intermediate, but there is no evidence of intergradation between the two taxa. Two specimens of *E. pumilus* subsp. *intermedius* were cited from Utah by Cronquist (1947). I have studied a duplicate of one of them (*Hobson and Gierisch* 13818, Cache Co.—UTC) and it is typical *E. engelmannii* A. Nels.; the other is from Salt Lake Co., an area where *E. engelmannii* is very common. In fact, I have seen no collections of *E. pumilus* from Utah.

In the range of *Erigeron concinnus* where it approaches that of *E. pumilus* subsp. *pumilus* (in Wyoming and Colorado), Cronquist himself (1947, 1955) apparently found no evidence of intermediacy that would indicate intergradation expected between conspecific subspecies. I have not made a detailed study of plants from this boundary area, but judging from the comments by Harrington (1964), the two taxa may even be allopatric in part of this area.

Erigeron concinnus is most easily distinguished from *E. pumilus* by its conspicuous outer pappus of very broad scales or squamellae; the outer pappus of *E. pumilus* consists of bristles, narrow squamellae, or a combination of the two. The inner pappus of *E. concinnus* has 5–15 bristles; that of *E. pumilus* has 12–22 bristles. Another feature that has been used in keys to separate these two taxa is the pubescence of the disc corollas—that of *E. concinnus* described as scabrous-puberulent, that of *E. pumilus* as glabrous to slightly puberulent or pubescent. At the microscopic level this can be seen as a qualitative difference. The corolla pubescence of *E. pumilus* is more typical of the majority of *Erigeron* species, being composed of scattered, relatively long, blunt-tipped, biseriate trichomes that often tend to be glandular near the apex (Type C trichomes, see Nesom 1976, 1980). The scabrous-puberulent appearance of *E. concinnus* is due to the presence of very numerous, short, sharp-pointed, three-celled (less commonly four- or five-celled) trichomes that have traditionally been called Zwillingshaare and that normally are found only on the achene surface. Type C trichomes are also common on the corollas of *E. concinnus*, but they usually are shorter than those of *E. pumilus* and the cell outlines tend to be very distorted; in contrast, I have not observed Zwillingshaare on any disc corollas of *E. pumilus*.

In agreement with Cronquist (1947), I have encountered a few collec-

tions of *Erigeron concinnus* (from west-central Colorado) consisting of plants with appressed or ascending stem pubescence, at least on the upper half or the stems; otherwise, they appear to be typical of the species. Although an explanation for the origin of this variation admittedly is speculative, I would suggest the hypothesis that hybridization with *E. engelmannii*, which typically has appressed pubescence, may be involved. Plants of *E. engelmannii* with somewhat spreading pubescence occur sporadically in the same region. In fact, it is likely that confusion in the identification of *E. concinnus* has been more due to its similarity and possible hybridization with *E. engelmannii* than with *E. pumilus*. I fully agree with Cronquist (1947), however, that *E. engelmannii* is a distinctive species. Any future taxonomic study of broader scope should include all three species.

I have annotated as *Erigeron concinnus* a series of collections from Sweetwater Co., Wyoming, that are among the few plants so identified that are not typical of the species as it is found over the main part of its range. This population system is fairly uniform in morphology; it apparently is the only form in Sweetwater Co. and is what Nelson called *E. wyomingensis* A. Nels. The Wyoming plants have noticeably narrower squamellae and the disc corollas must be examined microscopically to verify the presence of the few and small Zwillingshaare. Conceivably, this population system might be regarded as intermediate between *E. concinnus* and *E. pumilus* subsp. *intermedius*, but alternatively, it may simply represent variation such as sometimes occurs on the periphery of a species' range. Even if the former were true, however, the small amount and area of overlap would not justify the specific merger of *E. concinnus* with *E. pumilus*.

According to Cronquist (1947), "The varieties within the subspecies [of *Erigeron pumilus*, including *E. concinnus*] are very poorly defined, yet show geographic restriction and have such pronounced morphological differences as to demand taxonomic recognition." The form of *E. concinnus* (var. *condensatus* D. C. Eat.) that is monocephalous, subscapose, and usually less than ten centimeters tall occurs in Nevada in Clark, Lincoln, Elko, and White Pine counties but is particularly abundant in the latter (Fig. 2). Elsewhere, enclaves of this form occur throughout the range of the species, but intermediates sometimes can be found even within samples of single populations. However, because populations composed primarily of these monocephalous plants are easily recognizable and tend to be geographically clustered (on a small scale) within the range of *E. concinnus*, I believe it is useful to retain the formal taxonomic status of variety for them. Most of the plants of var. *condensatus* I have seen are white-rayed, but the ray color varies to pink and purple.

A sparsely pubescent to glabrous form occurs primarily in west-central and southwestern Colorado, northwestern New Mexico, and the LaSal Mountains of eastern Utah. Several collections of this form include plants with appressed or ascending pubescence on the upper part of the stems. In

order that these plants may be recognized taxonomically, I am transferring Cronquist's name for them (var. *subglaber*), at the same rank, to *E. concinnus* (see Taxonomy). A completely glabrous plant of *E. concinnus* was named *E. perglaber* S. F. Blake, based on a specimen collected by Palmer in 1869. It was treated as a distinct species in the Arizona flora by Kearney and Peebles (1969) and maintained as a doubtful record by Lehr (1978); Cronquist (1947) considered it to be a possible heterotypic synonym of his var. *subglaber*. Having studied the type, I concur with Cronquist and consider *E. perglaber* a form of *E. concinnus*, typical in every way except for the complete lack of long, uniseriate trichomes on the stems, leaves, and phyllaries. In this respect it is at the extreme of variability in plants recognized as var. *subglaber*. Further, whether this collection actually was made in Arizona is open to doubt—as stated by Blake (1940), “The data for Edward Palmer's ‘Arizona’ specimens of 1869 are so uncertain that this plant is ascribed to the State with some hesitation.”

Erigeron aphanactis (A. Gray) Greene was first named as *E. concinnus* var. *aphanactis* A. Gray. It has been treated as the latter in the Arizona flora (Kearney and Peebles, 1969; Lehr, 1978), but Cronquist (1947) and other floristicians, with whom I agree, have regarded it as a distinct species. In Nevada it is fully sympatric with *E. concinnus*, but there are no intermediates and the two have different overall geographic ranges, *E. aphanactis* growing to the northwest into northeastern California and southeastern Oregon.

TAXONOMY

1a. ERIGERON CONCINNUS (Hook. & Arn.) Torr. & Gray var. CONCINNUS, Fl. N. Amer. 2: 174. 1841.

Distasis concinna Hook. & Arn., Bot. Beechey Voy. 350. 1839. TYPE: [IDAHO]. Snake River, below the Salmon Falls, Snake County, [summer 1837], Mr. Tolmie s.n. (HOLOTYPE: GL-E!). According to the discussion by Hooker and Arnott, their set of specimens from the “Snake Country” actually was collected by “a friend of Mr. Tolmie.” From the discussion and geographic coordinates that they furnished it is possible to surmise with some certainty that the collection of *Distasis concinna* was made in southern Idaho; the Salmon Falls of the Snake River are in the northwestern corner of Twin Falls Co. about 20 kilometers northwest of the confluence of Salmon Falls Creek with the Snake River. This locality appears to be slightly northwest of what, based on other specimens I have studied (Fig. 1), is the northwestern tip of the range of *Erigeron concinnus*. Unfortunately, however, due to extreme insect damage the diagnostic portions of the flowers and achenes of the type collection are completely missing and it is not possible to certainly identify the plants as *E. concinnus* rather than *E. pumilus*. It is not implausible that the specimen is *E. concinnus*; because the original publication clearly describes a scaly outer pappus and because a guess that the type might actually be *E. pumilus* would necessitate several nomenclatural changes, I see no reason why the Tolmie collection should not continue to be associated with *E. concinnus*. At least the plants are similar in habit to what tradition has recognized as var. *concinna*, in contrast to var. *condensatus*.

Cronquist (pers. comm.) has indicated that he examined a type specimen of *Distasis concinna* at Kew, but the staff there was unable to relocate a specimen with collection data similar to that cited by Hooker and Arnott.

E. pumilus Nutt. subsp. *concinnoides* Cronq. Brittonia 6: 181. 1947. TYPE: NEVADA. Clark Co.: Charleston Mountains, Kyle Canyon, brushy hillside, juniper belt, 1350 m, 15 May 1937, *I. W. Clokey* 7743 (HOLOTYPE: NY; ISOTYPES: MIN, MO!, POM, RENO-3 sheets!, RM, US!, WS, WTU).

1b. *ERIGERON CONCINNUS* var. *CONDENSATUS* D. C. Eaton in S. Wats., U. S. Geol. Expl. 40th Parallel, Bot. 151. 1871. TYPE: [NEVADA. Elko Co.:], East Humboldt Mts., 8000 ft, July 1868, *S. Watson* 543 (HOLOTYPE: YU; ISOTYPES: NY, US!).

E. condensatus (D. C. Eaton) E. Greene, Bull. Torrey Bot. Club 24: 511. 1897.

Two collections were cited by Eaton after the description of var. *condensatus*, followed by the single Watson collection number "543." Judging from the format used for other taxa in the same treatment, the cited collection number clearly is the one meant to be associated with the new name; the YU specimen is marked as var. *condensatus*, *Watson* 543, from the second locality cited by Eaton and is the holotype.

Erigeron wyomingensis A. Nels., Bull. Torrey Bot. Club 26: 248–249. 1899. TYPE: WYOMING. [Sweetwater Co.]: Point of Rocks, 1 Jun 1897, *A. Nelson* 3088 (HOLOTYPE: RM!).

E. setulosus E. Greene, Pittonia 4: 319. 1901. TYPE: NEW MEXICO. [San Juan Co.]: Aztec, 28 Apr 1899, *C. F. Baker* 664 (HOLOTYPE: ND; ISOTYPES: RM!, US). Although it was not specifically cited by Greene, the ND sheet is clearly the one referred to in the original description. In Greene's own handwriting it was first identified as *Erigeron concinnus* then changed to *E. setulosus*, which is consistent with his published comment that it was "inadvertently referred by me, in Baker's distribution, to *E. concinnus*, from which it is now seen to be most distinct. . . ." Greene's sheet also lacks a specific Baker collection number, which also is consistent with the publication, but the RM and US duplicates are marked as *Baker* 664.

E. concinnus var. *cremicus* Jeps., Man. Fl. Pl. Calif. 1057–1058. 1925. TYPE: CALIFORNIA. San Bernadino Co.: *W. L. Jepson* 5464 (HOLOTYPE: UC).

1c. *ERIGERON CONCINNUS* var. *subglaber* (Cronq.) Nesom, comb. nov.

Erigeron pumilus subsp. *concinnoides* var. *subglaber* Cronq., Brittonia 6: 183. 1947. TYPE: UTAH. San Juan Co.: meadow S of Monticello, 2100 m, 24 Jul 1911, *Rydberg and Garrett* 9141 (HOLOTYPE: NY; ISOTYPES: RM, UC, US!).

E. perglaber S. F. Blake, J. Wash. Acad. Sci. 30: 471. 1940. TYPE: ARIZONA [?], without definite locality, 1869, *E. Palmer* s.n. (HOLOTYPE: US!).

ACKNOWLEDGEMENTS

I thank curators of E, ND, NSMC, RENO, RM, UC, US, and UTC for loans of specimens and the staff of MO for their hospitality during my study there, I am particularly grateful to Dave Boufford (GH), W. D. Clayton (K), Barbara Hellenthal (ND), Harold Robinson (US), and Jim Rodman (YU) for their essential assistance in supplying details regarding type collections and to Barney Lipscomb (SMU) for his expert help with literature. Susan Jackson's assistance with the preparation of Fig. 2 and the careful typing by Gloria Cox are greatly appreciated.

REFERENCES

- BARKLEY, T. M. (ed.). 1977. Atlas of the flora of the Great Plains. Iowa State Univ. Press, Ames.
- BLAKE, S. F. 1940. New species and new names among Arizona Asteraceae. J. Wash. Acad. Sci. 30: 467-472.
- CRONQUIST, A. 1947. Revision of the North American species of *Erigeron*, north of Mexico. Brittonia 6: 121-302.
- . 1955. Vascular plants of the Pacific Northwest. Part 5: Compositae. Univ. Washington Press, Seattle.
- HARRINGTON, H. D. 1964. Manual of the plants of Colorado (rev. ed.). Swallow Press, Denver.
- KEARNEY, T. H. and R. H. PEEBLES. 1969. Arizona flora (2nd ed. with suppl., by J. T. Howell, E. McClintock, and collaborators). Univ. California Press, Berkeley.
- LEHR, J. H. 1978. A catalogue of the flora of Arizona. Desert Botanical Garden, Phoenix.
- MARTIN, W. C. and C. R. HUTCHINS. 1981. A flora of New Mexico. J. Cramer Press, Vaduz, Liechtenstein.
- MUNZ, P. A. 1959. A California flora. Univ. California Press, Berkeley.
- NESOM, G. L. 1976. A new species of *Erigeron* (Asteraceae) and its relatives in southwestern Utah. Brittonia 28: 263-272.
- . 1980. A revision of the epappose species of *Erigeron* (Asteraceae-Astereae). Ph.D. dissertation, Univ. North Carolina, Chapel Hill.
- WELSH, S. L. and G. MOORE. 1973. Utah plants: tracheophytes (3rd ed.). Brigham Young Univ. Press, Provo, Utah.

REDISCOVERY OF *LESQUERELLA PALLIDA* (CRUCIFERAE)

ELRAY S. NIXON and JOHN R. WARD

Stephen F. Austin State University, Nacogdoches, TX 75962

and

BARNEY L. LIPSCOMB

Herbarium, Southern Methodist University, Dallas, TX 75275

In 1981, while searching for *Leavenworthia aurea* Torrey on Weches Formation outcrops, we collected a white-flowered *Lesquerella* that was later identified as *Lesquerella pallida* (Torrey & Gray) Watson. The *L. pallida* population inhabited an open grazed pasture associated with a Weches outcrop about 8 miles west of San Augustine, Texas. Some plants were actually growing on the Weches soil. This species was initially collected by Dr. M. C. Leavenworth in the 1830's on small prairies near San Augustine. Until now, no collections appear to have been made anywhere since the original one by Leavenworth (Rollins and Shaw, 1973). Because it had not been relocated and because of questionable flower color not adequately shown by the type specimen, Rollins and Shaw (1973) considered it a slightly anomalous specimen of *L. gracilis* (Hook.) Watson.

HABITAT

As mentioned, *L. pallida* is found on and nearby outcrops of the Weches Geologic Formation, which are generally exposed on hillsides. This formation usually consists of calcareous marine sediments underlain by a grayish-green layer composed of the clay mineral glauconite. As a result of the impermeability of this glauconite layer, Weches outcrops are seepy and wet much of the year. These characteristics result in a rather unique habitat as evidenced by Weches endemics in eastern Texas such as *Leavenworthia aurea*, *Lesquerella pallida*, and *Sedum pulchellum*. Plant species associated with *L. pallida* at the time of its flowering were *Allium drummondii*, *Arenaria drummondii*, *Astranthium intergrifolium*, *Cacalia plantaginea*, *Melilotus indicus*, *Phalaris caroliniana*, *Satureja arkansana*, and *Valerianella radiata*.

The evident association of *L. pallida* with the Weches Formation may be a result of soil chemistry. The basic pH (7.1–7.2) and generally high levels of most exchangeable ions, especially Ca and Mg (Table 1) are in contrast to the acid, sandy, leached soils usually encountered in eastern Texas. It appears that *L. pallida* is a heliophyte and thus may be present on Weches

TABLE 1. Physical and chemical properties of Weches and adjacent pasture soils.

Location	TEXTURE (%)			TEXTURAL Class	pH
	Sand	Silt	Clay		
Weches	78	8	14	Sandy loam	7.1
Pasture	51	27	22	Sandy clay loam	7.2

	EXCHANGEABLE IONS (PPM)						
	P	K	Ca	Mg	Fe	Mn	Zn
Weches	13	170	>6000	>400	>10	3	0.2
Pasture	12	230	4900	>400	>10	>5	0.4

and adjacent pasture areas because they are treeless. Weches outcrops are naturally treeless in forested eastern Texas, providing habitat for shade intolerant species. Forests, in contrast, are migration barriers in these circumstances and may be the prime factor causing the limited distribution of *L. pallida*. Some migration has occurred into adjacent cleared pastureland. This pastureland, however, appears to have soil characteristics similar to those of the Weches outcrop (Table 1).

POPULATION SIZE

Because the Weches Formation is a rather narrow layer, *L. pallida* is distributed as a band of plants covering approximately 2.02 ha (5 acres). We counted 3,319 plants in this area. We searched other Weches outcrops for the occurrence of *L. pallida* but other populations have not been found.

LESQUERELLA PALLIDA vs. LESQUERELLA GRACILIS

Lesquerella pallida was first recognized as a variety in 1838 by Torrey & Gray. It was, however, described as a variety of *Vesicaria grandiflora*, an auriculate species of loose sandy soils in southern and central Texas. In 1840 Torrey & Gray elevated *V. pallida* to a species of *Vesicaria*. Watson (1888) erected the genus *Lesquerella* and at the same time transferred *pallida* from *Vesicaria*, an old world genus, to *Lesquerella*. Rollins & Shaw recognized *L. pallida* as a good species in their treatment of *Lesquerella* in Correll & Johnston (1970).

Flower color is a distinguishing characteristic: *L. pallida* has white petals with a yellow base (Fig. 1), and *L. gracilis* has yellow petals. The two species have also been separated based on pedicel features: *L. pallida* has recurved

pedicels, and *L. gracilis* has ascending to spreading, straight pedicels (Correll & Johnston, 1970). Although useful, this character does not appear to be constant. The upward curvature of the stipe of *L. gracilis* is a more con-

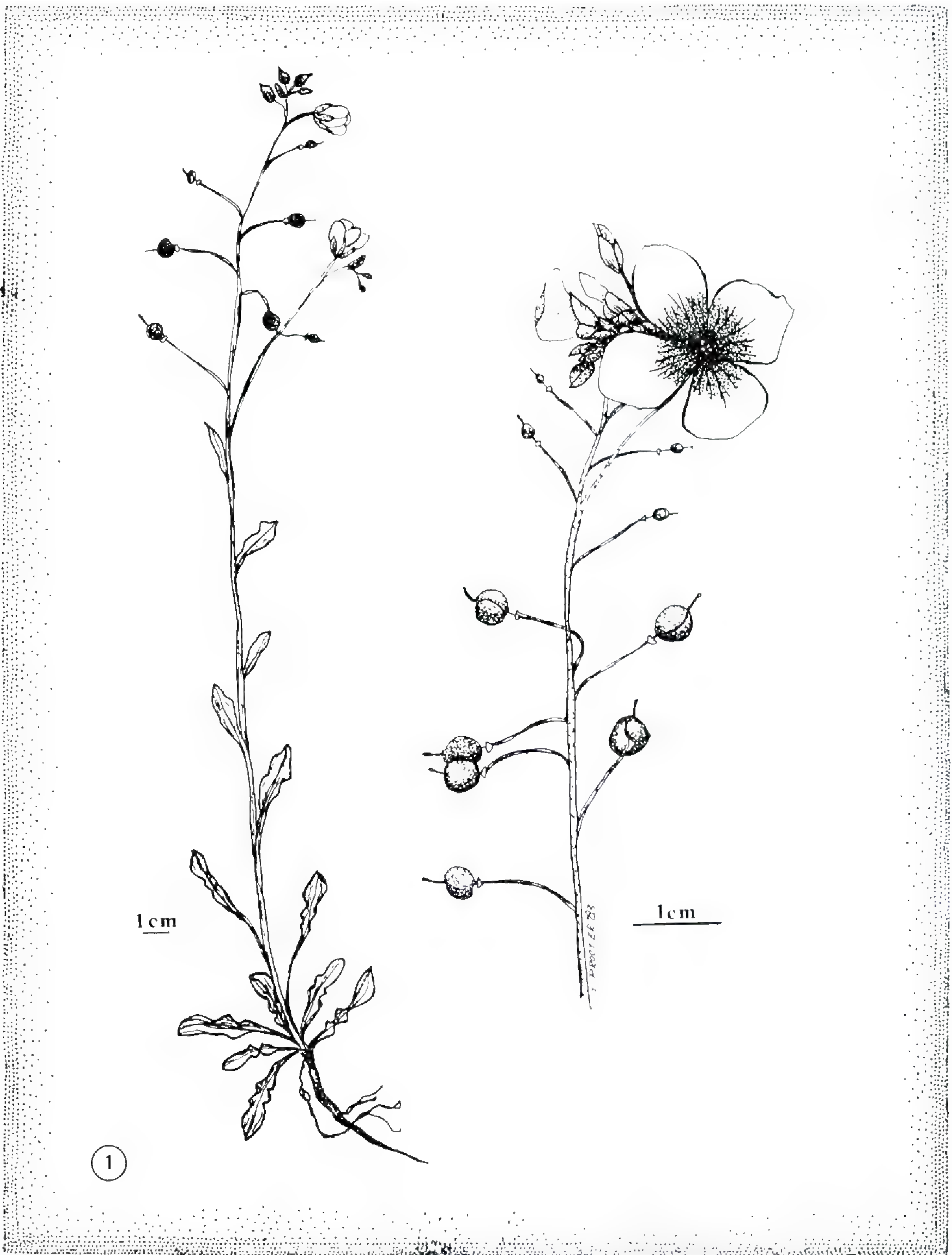


Figure 1. *Lesquerella pallida* (from Nixon & Ward, 10665, Nixon et al. 11784, and photographs).

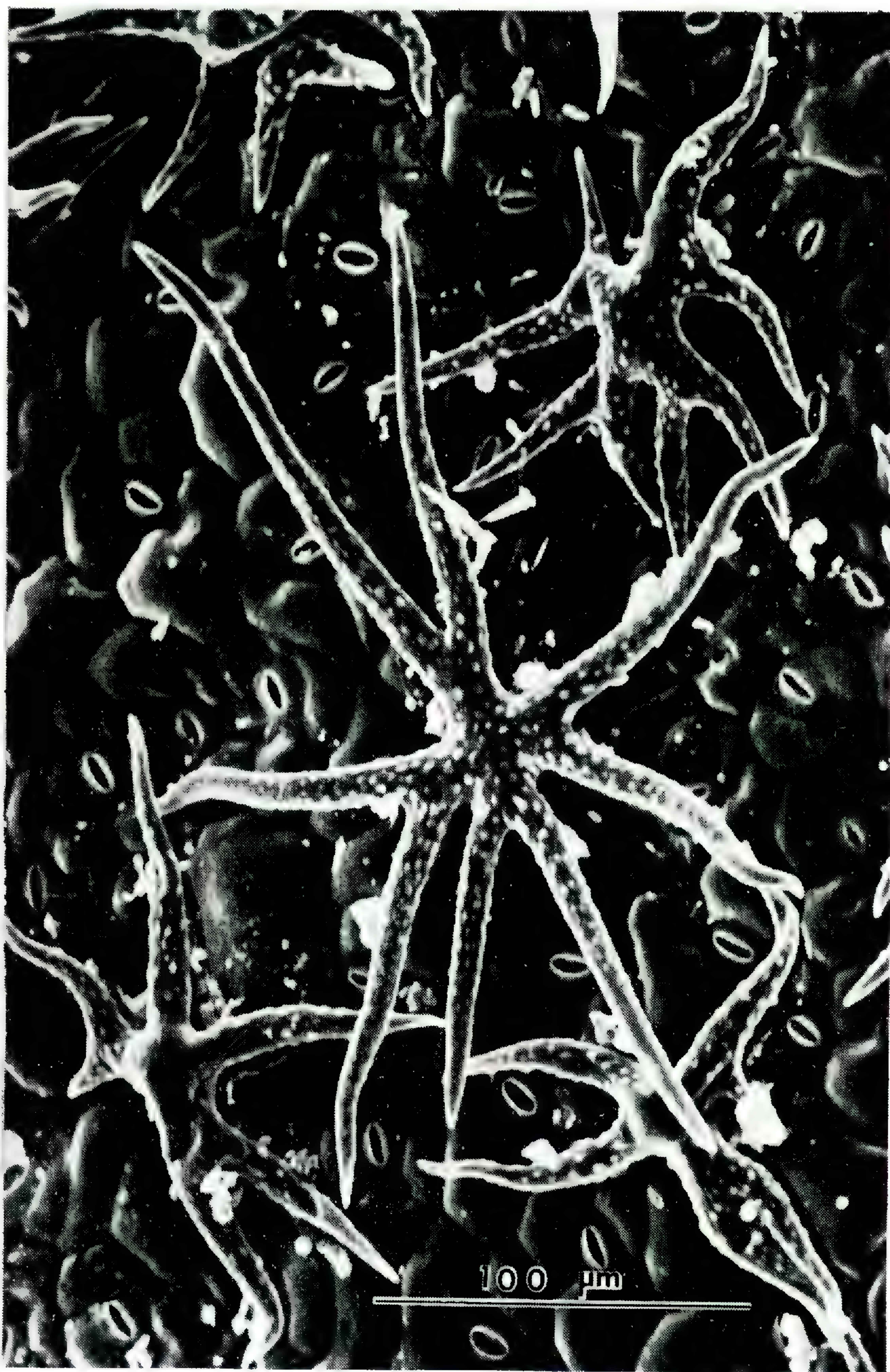


Figure 2. Trichomes of *Lesquerella pallida*.

sistent difference. Ovules of *L. pallida* average 4–6 per locule while those of *L. gracilis* average 8–10 per locule. Silicles of *L. pallida* appear to be larger on the average than those of *L. gracilis*.

Of interest are the differences in habitat. Herbarium labels and field work indicate that *L. gracilis* is generally found along roadsides, fencerows, and railroad embankments on limestone gravel and clay soils. Its nearest location to *L. pallida* is about 100 miles west. *Lesquerella pallida*, as discussed earlier, is associated with a unique geologic formation which is quite wet much of the year. However, all the factors causing its restricted distribution are not known.

We determined the chromosome number of *L. pallida* by squashing anthers in aceto-orcein stain. Microsporocyte counts indicate $n=6$ (Nixon *et al* 11784, ASTC). *Lesquerella gracilis* is also reported to have a chromosome number of $n=6$ (Rollins, 1966).

Preliminary studies on the two species' flavonoid profiles, as determined by paper chromatography, indicate they are distinctive. The flavonoid patterns are distinctive for both leaf and floral tissue (SMU: *L. PALLIDA*: Nixon *et al* 11784; *L. GRACILIS*: Barnette 35, Lundell & Lundell 10318).

DESCRIPTION

The original description of *L. pallida* was based on Leavenworth's specimen. Payson (1922) monographed *Lesquerella* and compiled his description from the original publication in Torrey and Gray's 'Flora' 1: 101. 1838. Since this is the first collection of this species since the 1830's, a new description follows based on flowering and fruiting specimens observed both in the herbarium and field.

LESQUERELLA PALLIDA (Torrey & Gray) S. Watson. Proc. Amer. Acad. 23: 253. 1888.

Vesicaria grandiflora Hook. var. *pallida* Torrey & Gray, Fl. N. Amer. 1: 101. 1838.

Vesicaria pallida (Torrey & Gray) Torrey & Gray, Fl. N. Amer. 1: 668. 1840.

An erect to spreading annual (?) usually branching at the base and/or in the upper parts, 5–60 cm tall; root system a small tap root (to 5 mm wide at the top) with lateral branches; stems slender (to 5 mm wide at the base), yellowish green to grayish green, sometimes reddish near the base with the reddish color extending upward on the upper side of the stem, decumbent to erect; leaves exstipulate, yellowish green to grayish green, linear to oblong to oblanceolate, entire to dentate, sometimes undulate, variously pinnately lobed in basal leaves, tips acute to obtuse to round, bases mostly attenuate, stellate pubescent on upper and lower surfaces, basal leaves to 10 cm long and 2 cm wide with petioles to 4 cm, cauline leaves gradually reduced upward, becoming sessile, extending into the inflorescence; inflorescences to 33 cm long, flowers solitary (in very small plants) or in



Figure 3. Pollen grains of *Lesquerella pallida*.

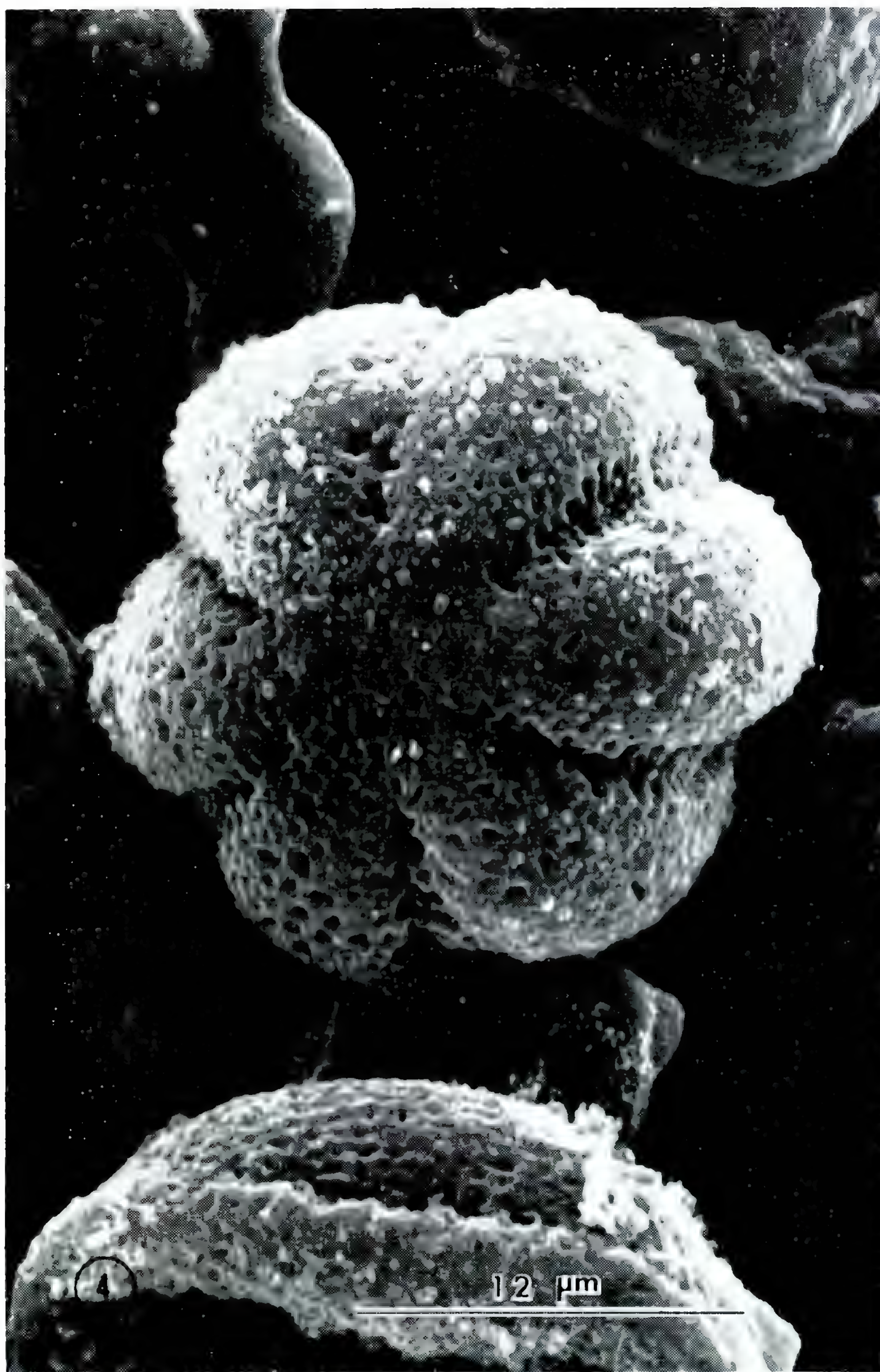


Figure 4. Polar view of a pollen grain of *Lesquerella pallida*.

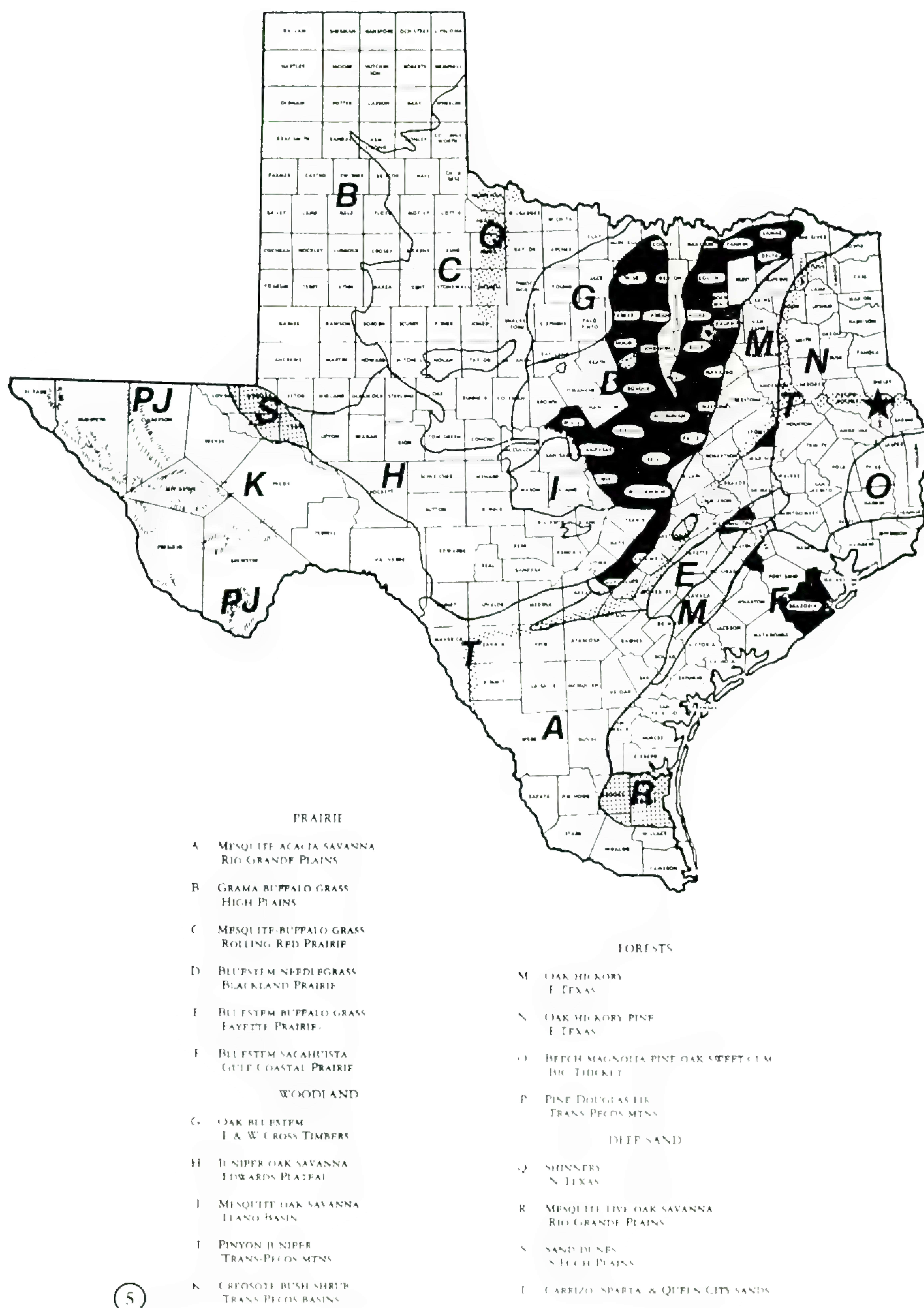


Figure 5. Distribution of *Lesquerella pallida* (star) and *L. gracilis* (shaded area) based on collections at SMU and data from Rollins & Shaw (1973).

racemes, racemes to 16 cm long and containing up to 24 flowers; pedicels to 18 mm long, slightly recurved at maturity; sepals 4, greenish in the bud, becoming cream colored to yellowish orange with maturity, hyaline margined, to 5 mm long and 2 mm wide, acute, sessile, stellate, oblong to narrowly ovate; petals 4, white with a yellow base and brownish to olive colored veins, to 12 mm long (the yellow base to 5 mm long) and 8.5 mm wide, broadly ovate, narrowing somewhat abruptly to a narrow (about 1 mm long) base, glabrous; stamens 6, tetradynamous, filaments to 4.8 mm long, anthers bright yellow, versatile, to 2 mm long, pollen 5 colpate rarely 6 colpate; pistils (in flowers) to 5 mm long and 1.5 mm wide, ovaries to 2.3 mm long, styles to 3.1 mm long, stigmas to 0.5 mm long; fruits (silicles) globose to ellipsoid, stipitate (stipes to 1.2 mm long), to 5.5 mm long and 6 mm wide, glabrous; ovules usually 4–6 per locule; seeds 2 mm long and 1.6 mm wide, flattened (Figs. 1-4).

Distribution (Fig. 5). Endemic to the Weches Geologic Formation outcrops, San Augustine County, Texas. Flowering April and May.

TYPE: TEXAS. San Augustine Co.: small prairies near San Augustine, M. C. Leavenworth s.n., probably 1837–1838 (HOLOTYPE: NY, microfiche SMU!; fragments of type: GH).

Specimens examined: TEXAS. San Augustine Co.: open pasture area of Weches Formation outcrop, 8 mi W of San Augustine on Hwy 21 and 1 mi S, 10 Apr 1981, Nixon & Ward 10665 (ASTC, SMU); 16 Apr 1982, Nixon et al 11784 (ASTC, SMU).

CONCLUSIONS

The rediscovery of *L. pallida* indicates that the taxon is reproductively and geographically isolated from other *Lesquerella* species. Its habit, habitat, range, and chemical distinctness distinguish it from *L. gracilis*.

ACKNOWLEDGEMENTS

We want to thank Jessica Procter for the illustration, Robert Roberson for electron microscopy and John Bacon for his help with the paper chromatography.

REFERENCES

- CORRELL, D. S. and M. C. JOHNSTON. 1970. Manual of the vascular plants of Texas. Texas Research Foundation, Renner, Texas.
- PAYSON, E. B. 1922. A monograph of the genus *Lesquerella*. Ann. Missouri Bot. Gard. 8: 103–236.
- ROLLINS, R. C. and E. A. SHAW. 1973. The genus *Lesquerella* (Cruciferae) in North America. Harvard Univ. Press, Cambridge, Massachusetts.
- TORREY, J. and A. GRAY. 1838. A flora of North America. 1: 101. Wiley and Putnam, New York.
- . 1840. A flora of North America. Supplement. Additions and emendations 1: 668. Wiley and Putnam, New York.
- WATSON, S. 1888. Contributions to American botany. XV. Proc. Amer. Acad. Arts 23: 253.

NEW SPECIES, NEW COMBINATIONS AND NOTES ON THE GOLDENRODS (*EUTHAMIA* AND *SOLIDAGO*—*ASTERACEAE*)

CONSTANCE E. S. TAYLOR AND R. JOHN TAYLOR

*Biology Department, Southeastern Oklahoma State University,
Durant, OK 74701*

During the last 25 years, we have studied the goldenrods, collecting almost all recognized species and studying them in their native habitat and at their extremes of range. Every state in the United States, except Hawaii, has been visited, as well as most provinces of Canada and the Yukon Territory. *Solidago* and/or *Euthamia* specimens have been examined from the following herbaria: ALA, ALTA, ASTC, ASU, COLO, CONN, CS, CSU, DUR, ECSC, F, FAY, FSU, GA, GH, ILL, KSTC, LAF, MAINE, MARY, MIN, MISS, MO, MONT, MONTU, MUR, MT, ND, NEBC, NLU, NMC, NO, NYS, OCLA, OKL, OKLA, OLDS, OSC, PENN, PH, RM, SAT, SMU, SRSC, TAES, TENN, TEX, TTC, TULS, UAC, UARK, UBC, UNA, US, USCH, USTA, UT, VSC, WIN, WTS, WTV. Over 200 *Solidago* and numerous *Euthamia* types have been examined and photographed. As a result of these studies, the following name changes should be made within these genera.

1. *EUTHAMIA GRAMINIFOLIA* (L.) Nutt. var. **HIRTIPES** (Fern.) C. & J. Taylor, comb. nov.

X *Solidago hirtipes* Fernald, *Rhodora* 48: 65. 1946. TYPE: VIRGINIA, Sussex Co.: roadside; thicket about 1.5 m N of Waverly, 13 Sep 1945, *Fernald and Long* 15015 (GH!, PH!).

Fernald described this taxon indicating its probable origin from hybridization between *E. graminifolia* and *E. microcephala* (Greene) Bush [the latter is a synonym of *E. tenuifolia* (Pursh) Nutt.] There is no evidence that this taxon is a hybrid. All characters including leaf length and width, number of flowers, pubescence, and height are similar to *E. graminifolia* var. *nuttallii* (a scabrous-pubescent variety) except that rather than glomerate heads, they are mostly pedicellate. Two other species of *Euthamia*, *E. tenuifolia* and *E. gymnospermoides* have heads pedicellate. In these species, the heads are more glomerate in plants growing at the northern end of their range.

Both *Euthamia graminifolia* var. *graminifolia* (the glabrous variety), and *E. g.* var. *nuttallii* are abundant in the northeastern United States and Canada. They appear to integrate as we have seen specimens vary from essentially glabrous through all densities to very pubescent. The variety *hirtipes* is uniformly medium pubescent. It ranges from the coastal plain of southeastern

Virginia south through the Carolinas, and from the Gulf coast of central western Florida westward to Vermilion Parish in coastal Louisiana (Fig. 1). Examination of material at FSU, GA, VSC yielded no specimens collected along the southern Atlantic coast of Georgia and Florida. Sieren (1970, 1981) reports this plant only from Virginia and the Carolinas. However, Louisiana and Alabama specimens date back to the 1800's and Mohr (1901) lists *E. graminifolia* for Mobile County, Alabama as does Lelong (1977). These Gulf coast plants are not mentioned in the discussion under the taxa *hirtipes* or *graminifolia* by Sieren (1970, 1972, 1981).

2. *EUTHAMIA TENUIFOLIA* (Pursh) Nutt. var. *PYCNOCEPHALA* (Fern.)
C. & J. Taylor, comb. nov.

Euthamia galetorum Greene. Leaflet. Bot. Observ. Crit. 2:152. 1911. TYPE: CANADA. NOVA SCOTIA: margin of Lake Pleasant, near Springfield, 8 Aug 1910, E. L. Greene s. n. (ND-G 59!).

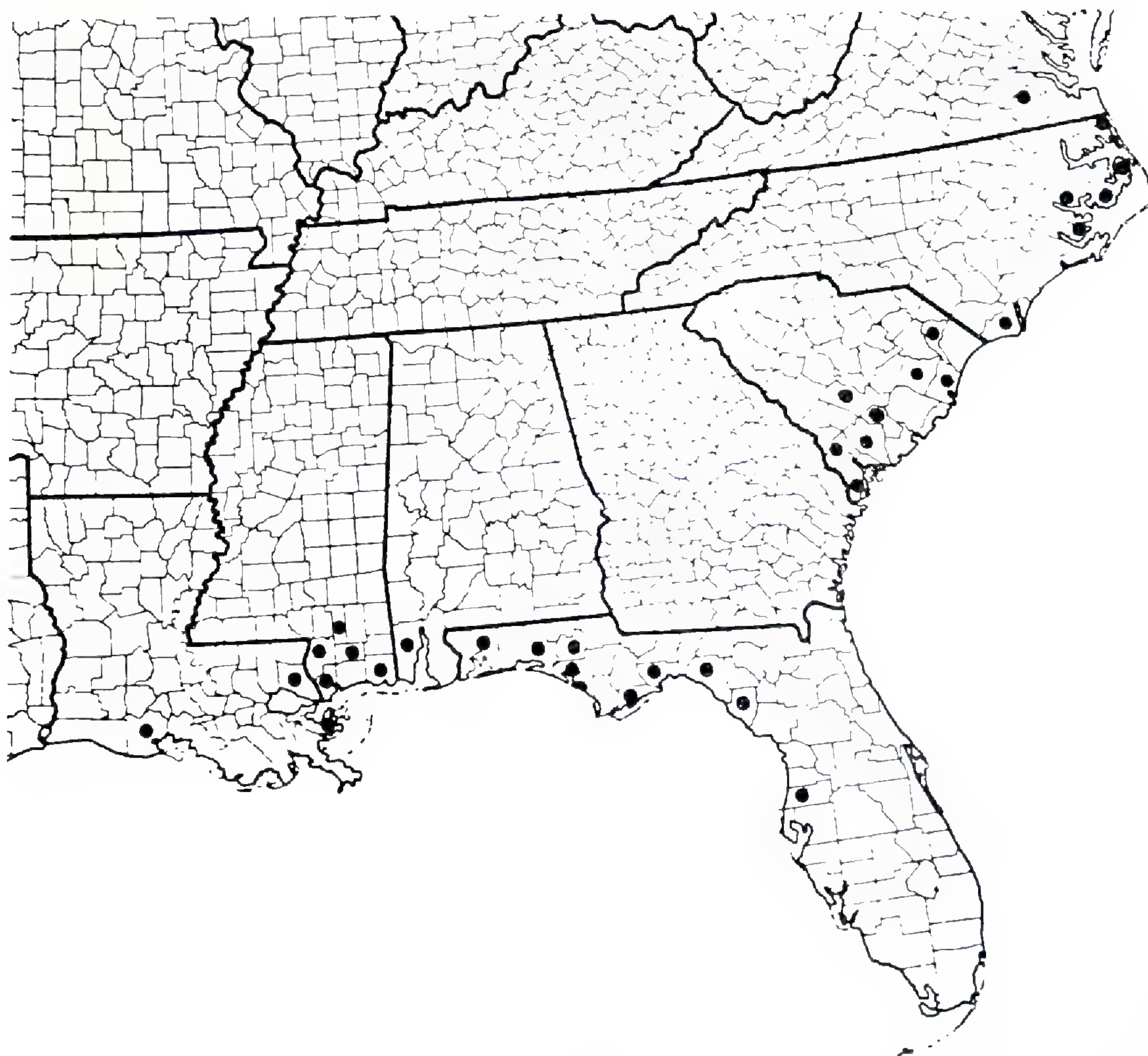


Figure 1. Distribution of *Euthamia graminifolia* (L.) Nutt. var. *hirtipes* (Fern.) C.&J. Taylor.

Solidago tenuifolia Pursh var. *pycnocephala* Fern. Rhodora 23:293. 1921. TYPE: CANADA. NOVA SCOTIA. Yarmouth: wet lower peaty and cobbly beach of Salmon (Greenville) Lake, 13 Aug 1920, *Fernald, Bissell, Graves, Long, and Linder* 22743 (GH!, PH!, US!).

Solidago graminifolia (L.) Salisb. var. *galetora* (Greene) House. New York State Mus. Bull. 243–244: 45. 1923.

Solidago galetorum (Greene) Friesner. Butler Univ. Bot. Stud. 3(1):58. 1933.

[Sicren (1981) cites "*Euthamia graminifolia* (L.) Nutt. var. *galetorum* (Greene) Friesner, Butler Univ. Bot. Stud. 3(1): 58. 1933" as a synonym. This name is a typographical error. Friesner was evidently citing *S. g.* var. *galetora* (Greene) House as a synonym and the *S.* was misprinted as an *E.*]

This taxon has been considered an endemic Nova Scotia species and as a variety of both *S. graminifolia* and *S. tenuifolia*. Field studies along with examination of types and other herbarium specimens support Fernald's treatment as a variety of *tenuifolia*. The proper combination had not been made under the genus *Euthamia*.

3. *SOLIDAGO ALTIPLANITIES* C. & J. Taylor, sp. nov.

Plantae perennes caespitosae et per rhizomata repentes extendentes colonias parvas facientes, usque ad 5–8 dm altae; caulis pilis brevis distaliter adpressis dense vestitis; foliis basalibus per anthesin deciduis, foliis caulis principalis magnitudine aequalibus; foliis linearibus, plerumque 6–9 cm longis, 5–6 mm latis, triplinervis, subglabris vel dense pubescentibus apprimae in nervo medio, marginibus ciliatis; inflorescentiis terminalibus, paniculatis, usque ad 30 cm altis et 20 cm latis, ramis erectis, plerumque non recurvis sed capitulis secundis, in pedicellis brevis bracteis brevis numerosis 2 mm longis, 0.5 mm latis; bracteis involucri triseriatis vel quadriseriatis, 5 mm altis, glabris marginibus ciliatis apicem versus, marginibus infernis membranaceis; floribus (10) 12–14 (20) per capitulum, floribus ligulatis atque discis aequalibus, acheniis perberulis.

Perennial in clumps and spreading by creeping rhizomes to form small colonies; up to 5–8 dm tall, stem densely pubescent with short upwardly appressed hairs, basal leaves deciduous at time of flowering, leaves similar in size on the primary stem; leaves linear usually 6–9 cm long, 5–6 mm wide, triple nerved, nearly glabrous to densely pubescent especially on the midrib, margins ciliate, inflorescence terminal, paniculate, up to 30 cm tall and 20 cm wide, branches erect, generally not recurved, but heads secund on short pedicels with numerous short bracts 2 mm long, 0.5 mm wide; involucre bracts imbricate in 3 or 4 rows, 5 mm long, bracts glabrous with ciliate margins near the tip, the lower margins membranous; flowers (10) 12–14 (20) in a head, ray and disk flowers equal, achenes pubescent.

Etymology: Based on its occurrence in the High Plains region of Oklahoma and Texas.

TYPE: OKLAHOMA. Jefferson Co.: escarpments of the Red River, NW of OK Hwy 79 bridge, about 5.6 mi SW of Waurika, 9 Oct 1981, *J. & C. Taylor* 31007 (HOLOTYPE: DUR; ISOTYPES: GH, MO, NLU, NY, OCLA, SMU, US, WTS) (Fig. 2).

Plants occur on gypsum and shale bluffs along canyons usually adjacent



Figure 2. Holotype of *Solidago altiplanities* C.&J. Taylor.

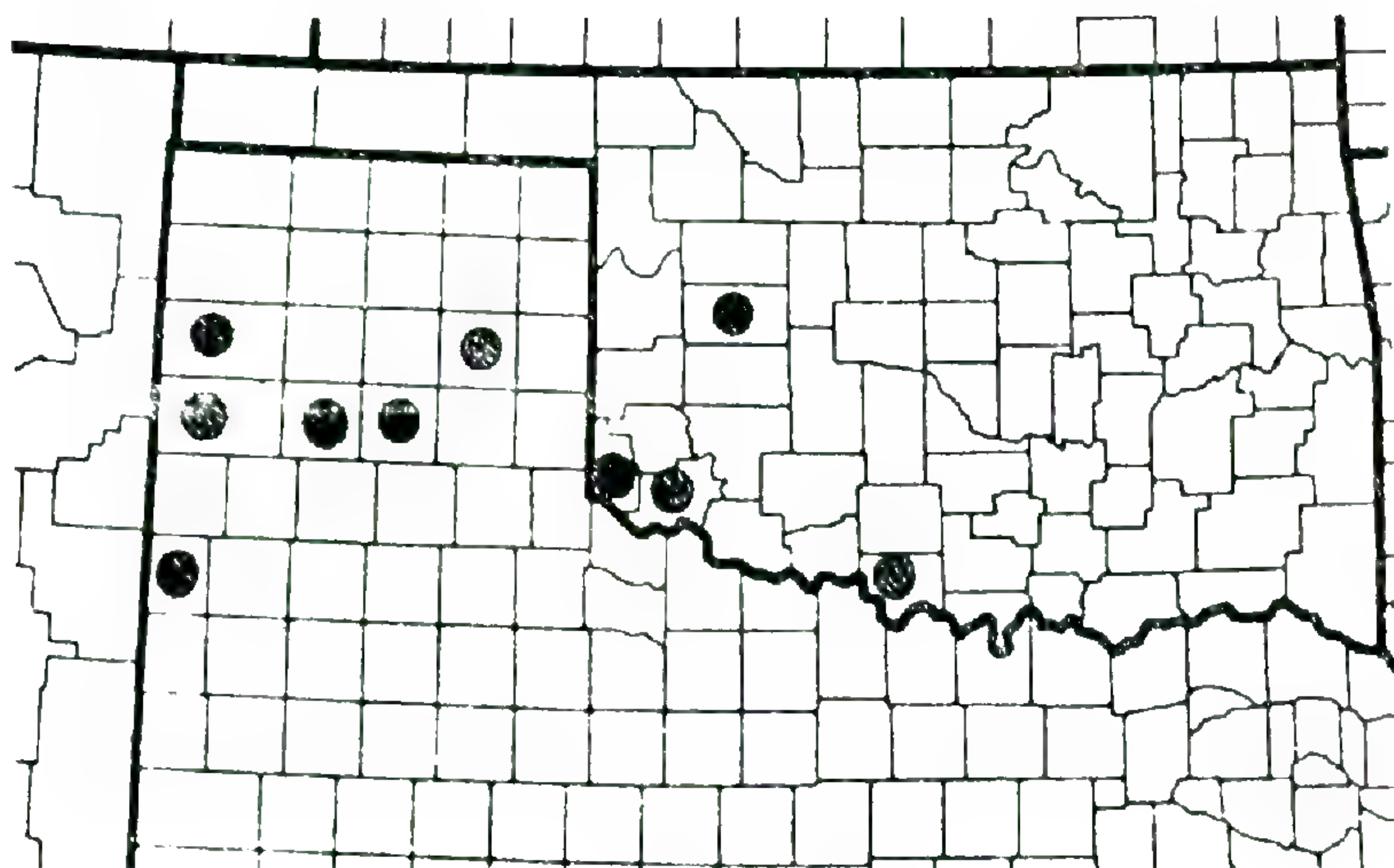


Figure 3. Distribution of *Solidago altiplanities* C.&J. Taylor.

to stream or river valleys. The soils are poor, forming muck when wet. The type specimen was collected during a year of good rainfall. Plants modified by environmental conditions have a much smaller inflorescence, sometimes even producing a tight cylindrical panicle. Plants are much smaller in height with shorter (4–5 cm) leaves under conditions of drought or when growing in areas of poor rain infiltration.

Plants are often found growing with *Solidago petiolaris* and *S. mollis*. Pubescence and size of flower heads are similar to *S. canadensis* and might indicate affinities with that species; however, erect inflorescence branches, and linear leaves cause it to not resemble any of the varieties of that species. While their ranges overlap, their habitats are markedly different.

Specimens examined (Fig. 3): OKLAHOMA. CUSTER CO.: north edge of I-40 on east side of Bear Creek Valley, gypsum and red marl soils, 6.5 mi E of Clinton, 21 Oct 1982, *C. Taylor* 31791 (DUR, SMU), north side of I-40, 8 mi W of Weatherford, 24 Oct 1982, *Taylor* 31812 (DUR, SMU); HARMON CO.: rocky hills south of Salt Fork of the Red River about 8.2 mi NW of Vinson, near bridge of OK Hwy 30, 29 Sep 1978, *J. Taylor and J. Sandidge* 27006 (DUR), along escarpment at top of canyon 0.8 mi S of the Elm Fork of the Red River along OK Hwy 30, 10 Oct 1981, *J. & C. Taylor* 31057 (DUR, SMU); JACKSON CO.: gypsum bluffs overlooking Red River, 4 mi S and 4 mi E of El Dorado, 4 Oct 1975, *C. and J. Taylor* 20782 (DUR), escarpments and canyons in eroded red shale and gypsum on north side of Red River, 3.4 mi S and 3.5 mi E of El Dorado, 28 Sep 1978, *J. Taylor and J. Sandidge* 26459 (DUR); JEFFERSON CO.: along the Red River, 5.6 mi SW of Waurika, 29 Sep 1978, *Taylor & Sandidge* 26940 (DUR), from section line road 0.3 mi N of US Hwy 70, 3 mi E of the Jefferson-Cotton County line, 4 Oct 1975, *J. & C. Taylor* 20614 (DUR). TEXAS. ARMSTRONG CO.: occasional on caprock ledges, Palo Duro Canyon, 15 mi S. of Claude, 7 Oct 1967, *F. R. Waller, Jr.* 1964 (DUR); BAILEY CO.: Sand dunes, 1 mi S of Muleshoe, 1 Sep 1969, *T. C. Rorson* 1694 (DUR); DEAF SMITH CO.: occasional, rocky slopes above Tierra Blanca Creek in Hereford, 20 Aug 1967, *F. R. Waller, Jr.* 1519 (SMU), loam

slopes along Tierra Blanca Creek, 6 mi SW of Hereford, 11 Sep 1966, *F. R. Waller* 1212 (SMU), arroyo in redbeds below caprock breaks, South Bridwell Ranch, 17 Sep 1967, *F. R. Waller* 1583 (SMU); GRAY CO.: along RR track near small grain building in McLean, 24 Oct 1982, *C. Taylor* 31801 (DUR, SMU); OLDHAM CO.: 4 mi E of Glen Rio, 19 Oct 1945, *Cory* 50379 (GH), along I-40 on the west facing escarpment zone at the west edge of the Staked Plains 14 mi E of Glen Rio, 21 Oct 1982, *C. Taylor* 31796 (DUR, SMU); RANDALL CO.: Palo Duro Canyon, 18 Oct 1975, *J. & C. Taylor* 20917 (DUR), and Palo Duro State Park, 20 Oct 1945, *Cory* 50406 (GH).

4. *SOLIDAGO CAESIA* L. var. *CAESIA* Sp. Pl. 2:879. 1753.

S. flexicaulis L. as to specimen in LINN, but not description in Sp. Pl. 2:879.

S. caesia var. *axillaris* (Pursh) Gray. Proc. Amer. Acad. Arts 17:189. 1882.

S. axillaris Pursh, Fl. Amer. Sept. 2:542. 1814.

KEY TO THE VARIETIES OF *S. CAESIA*

1. Plants glabrous to very sparsely pubescent.
 2. All flowers axillary in the axis of leaves, which are similar in size and shape to the stem leaves
 3. Stem round, leaf blade not decurrent on the stem var. *caesia*
 3. Stem striate, square-shaped, leaf blade becoming decurrent down the stem var. *curtisii*
 2. Lower flowers axillary in leaves, upper leaves becoming smaller and bract-like, producing a terminal inflorescence.....var. *paniculata*
1. Plants pubescent, tomentose-villous above.....var. *hispida*

4a. *SOLIDAGO CAESIA* var. *CURTISII* (T. & G.) C. & J. Taylor, comb. nov.

Solidago curtisii T. & G., Fl. N. Amer., 2:200. 1842. TYPE: NORTH CAROLINA. Black Mountains, Alt. 4500 ft, Sep, *A. M. Curtis* 1310 (PH!).

In Torrey and Gray's descriptions we find that the differences in the two species as they described them were: *S. caesia* stem terete, glabrous and *S. curtisii* stem striate-angled, nearly glabrous. The stem terete and striate-angled is the main character used to separate the plants in manuals. In the type specimen of *S. curtisii* at PH, the sessile leaf is about 1 mm wide on each side of the midrib where the leaf attaches to the stem. Thus the leaf is slightly decurrent on the stem and produces the striate stem character used to separate the taxon. Both *S. caesia* and *S. curtisii* are distinctly different from other *Solidagos* with their lanceolate serrate leaves and small axillary clusters of heads. Examination of both herbarium specimens and plants in the field indicate that there is no difference in habitat or other growth conditions that would not be apparent from herbarium specimens, and therefore we feel that the maintenance of *S. curtisii* as a separate species is unwarranted. Other named varieties are pubescent or are plants where the upper leaves have become reduced and bract-like changing the appearance from all flowers axillary to that of having a somewhat terminal prolonged raceme or narrow panicle.

- 4b. *SOLIDAGO CAESIA* var. *PANICULATA* Gray, Proc. Amer. Acad. Arts 17:189. 1882.

S. gracilis Poir., Encycl. 8:476. 1808.

S. flaccidifolia Small, Bull. Torrey Bot. Club 25:477. 1889.

- 4c. *SOLIDAGO CAESIA* var. *HISPIDA* Wood, Classbook (Ed. 1):197. 1885.

S. pubens Curtis in T. & G., Fl. N. Amer. 2:198. 1842.

S. curtisii var. *pubens* (Curtis) Gray, Proc. Amer. Acad. Arts 17:190. 1882.

5. *SOLIDAGO MISSOURIENSIS* Nutt. var. *TENUISSIMA* (Wooton & Standley) C. & J. Taylor, comb. nov.

Solidago tenuissima Wooton & Standley. Contr. U. S. Natl. Herb. 16:182. 1913.

TYPE: NEW MEXICO: from Guadalupe Canyon near Cloverdale, 15 Jul 1892, Mearns 466 (US!).

This taxon was considered by Kearney & Peebles (1951) as a synonym of *S. missouriensis* and since then, this tall, sparsely leaved western montane variety has not been recognized in floras. This variety grows along stream edges and wet areas of the Rocky Mountains, especially the Ponderosa Pine Zone. We have seen specimens from Arizona, New Mexico, and Colorado. Plants are 7–8 dm tall. The base of the stem is densely and closely sheathed with leaf petioles, the basal leaves being absent at anthesis. Stem leafy, leaves linear up to 11 cm long and 0.6 cm wide, gradually diminished upward to 4 cm long by 0.2 cm wide; fastigiate branching not present. Inflorescence longer than broad, branches up to 4 cm long, generally not much recurved, sparsely pubescent to glabrate. Upper leaves with occasional teeth, 2 or 3 to a side and over 1 mm long, apices acute. Plants sparsely pubescent to glabrous in the inflorescence.

6. *SOLIDAGO WRIGHTII* Gray, Proc. Amer. Acad. Arts 16:80. 1880.

TYPE: TEXAS: mountains between the Limpia and the Rio Grande [probably in Davis Mts. in Jeff Davis or Culberson Co., (McKelvey, 1955)] Aug 1849. *Wright* (Gray's assigned No. 281) (GH!, US!); and from Mt. Graham, Az, alt. 9,000 ft, *Rothrock* 730 (GH!).

This taxon has been a taxonomic and a nomenclatural problem. A species of the southwest, with large heads and ovate leaves, appears to be closely allied to *Solidago petiolaris* Ait. of the central and eastern United States. Its inflorescence varies from a densely flowered much branched panicle to few heads (6–8) on long peduncles forming a cymose type flat-topped terminal inflorescence. Herbarium specimens of the extremes and every variation in between in a continuum is clearly evidence for gene flow between the two forms. Gray (1880) named the paniculate form *S. bigelovii* (a nomen nudum) and the form with somewhat cymose inflorescences *S. wrightii*.

Two years later Gray (1882) evidently recognizing both forms as being related, published a description of *S. bigelovii* and placed *S. wrightii* as a

variety. This combination is invalid since *S. wrightii* has precedence over *S. bigelovii*. To complicate matters, *Solidago wrightii* var. *adenophora* was described by Blake (1929) as a variety having stipitate glands on the involucre, pedicels, stem, and leaves. The type at US is not only densely glandular pubescent, it has a robust panicle. The types of both *S. wrightii* (GH!, US!) and *S. bigelovii* (GH!, PH!) are densely pubescent and without stipitate glandular hairs. Examination of herbarium specimens from the southwestern United States shows every shade of gradation from pubescent only with short nonglandular hairs to a mixture, to all hairs being stipitate glandular. Both types, cymose and paniculate inflorescences, can be glandular or eglandular pubescent. Thus 4 extremes may be found: cymose-glandular, cymose-eglandular, paniculate-glandular and paniculate-eglandular pubescent. It is most probable that the difference in inflorescences and head number is based on greater genetic diversity than the variation in types of pubescence. Therefore, two varieties should be recognized rather than four, and the inflorescence rather than pubescence used to separate them.

- A. Heads cymose, singular or few on long pedicels forming a somewhat flat-topped inflorescence..... *S. wrightii* var. *wrightii*
- A. Heads in panicles, generally lower branches in inflorescences leafy, flowers clustered towards the ends..... *S. wrightii* var. *adenophora* Blake (*S. bigelovii* Gray)

ACKNOWLEDGEMENTS

We thank the American Association of University Women who enabled C. Taylor to examine all of the *Solidago* and *Euthamia* types at GH, PH and US. Special thanks to Paul Fryxell for the Latin description and advice on the *Solidago wrightii*—*S. bigelovii* problem. We also thank Wm. F. Mahler and Barney L. Lipscomb of SMU for their help.

REFERENCES

- BLAKE, S. F. 1929. New Asteraceae from the United States, Mexico and Honduras. J. Wash. Acad. Sci. 19: 269.
- KEARNEY, T. H. & R. H. PEEBLES. 1951. Arizona flora. Univ. of California Press, Berkeley.
- LELONG, M. G. 1977. Annotated list of vascular plants in Mobile, Alabama. Sida 7(2): 118–146.
- McKELVEY, S. D. 1955. Botanical explorations of the Trans-Mississippi West, 1790–1850. Arnold Arboretum of Harvard Univ., Jamaica Plains, Mass.
- SIEREN, D. J. 1970. A taxonomic revision of the genus *Euthamia* (Compositae) Ph. D. Dissertation, Univ. of Illinois Library, Urbana.
- . 1972. A new combination in the genus *Euthamia*. Phytologia 23(3): 304.
- . 1981. The taxonomy of the genus *Euthamia*. Rhodora 83: 551–579.

STIPA CURVIFOLIA (POACEAE)—STUDIES ON A RARE TAXON¹

STEPHAN L. HATCH

*Department of Range Science, Texas A&M University
College Station, TX 77843*

and

DAVID A. BEARDEN

Otis Orchard, WA 99027

ABSTRACT

New distribution records are reported for four locations in New Mexico, one in Texas, and one in Mexico. The first count for meiotic chromosome divisions is reported as $2n = 44$. Pollen fertility and caryopsis germination tests were made in an attempt to explain the rarity of the species. Scarcity of the specific habitat, limestone rock with chert or limestone derived soils on north facing slopes, is apparently more important in restricting distribution than the plant's reproductive capabilities.

The grass *Stipa curvifolia* Swallen was originally collected by H. Wilkens on 29 April 1932 in crevices of limestone cliffs near the mouth of the North Fork of Rocky Arroyo, Guadalupe Mountains, Eddy Co., New Mexico. Swallen (1933) described this species based on the *Wilkens 1660* (US) collection and reported the species as closely related to *S. occidentalis* Thurb.

The taxon has been treated as a distinct species, known only from the type collection, by Hitchcock (1935), Chase (1951), and Martin & Hutchins (1980). Floristic treatments from Mexico (Beetle, 1977) and the adjacent states of Texas (Correll & Johnston, 1970 and Gould 1975), and Arizona (Gould, 1951), make no reference to this species.

In 1978, Bill Issacs (pers. comm.) of the New Mexico State Heritage Program, questioned the validity of the species and was unable to find distribution data. The species was being considered for placement on The Federal Endangered and Threatened Plant Species List because of a lack of knowledge concerning the species. The objectives of this study were to determine the distribution of *S. curvifolia* and investigate possible mechanisms restricting its distribution.

MATERIAL AND METHODS

The species was recollected in the area of the type locality. Observations were made concerning soil type, associated species, and aspect. Several loca-

¹ This is Technical Bulletin No. T.A. 18649, Texas Agricultural Experiment Station.

tions in southern New Mexico and West Texas with similar ecological parameters were visited to search for the species. Herbarium specimens of *S. curvifolia* were requested for study and collection locations.

Populations of *S. curvifolia* were located and samples were collected throughout the growing season for chromosome counts, pollen fertility studies, and caryopsis germination tests. The acetocarmine smear technique (Smith, 1947) was utilized to investigate chromosomes and meiotic behavior in the pollen mother cell (PMC). Chromosome smears were made for the *Bearden & Hatch* 202 and 204 populations.

Pollen fertility was tested using cotton blue in lactophenol (Hauser and Morrison, 1964). Pollen from the anthers of five plants per population was mixed and stained for each of four populations. Pollen that stained dark blue was considered fertile while pollen that did not stain or was lightly stained was considered sterile. Caryopsis germination was tested using 200 caryopses from the *Bearden and Hatch* 205 population. The caryopses were placed in glass trays on damp filter paper, placed in a dark room with a temperature of 22°C for four days. Half of the caryopses were subjected to a cold treatment of -4°C for 24 hours prior to testing germination. One hundred other caryopses were stored in the laboratory for four years to test the germination percentages after storage.

All collection numbers of the authors and vouchers are deposited in the Tracy Herbarium (TAES), and New Mexico State University Biology Herbarium (NMC). Other specimens are from the University of Texas Herbarium (TEX) and the E. L. Reed Herbarium (TTC).

RESULTS

Populations of *S. curvifolia* were collected by the authors in five locations. Four are new distribution records for New Mexico (Table 1). Herbarium specimens from TEX and TTC were new distribution records for Mexico and Texas (Table 1). The locations were on north facing slopes of dry mountains with the following associated species: *Bouteloua curtipendula* (Michx.) Torr., *Stipa lobata* Swallen, *Elymus longifolius* (J. G. Smith) Gould, *Aristida longiseta* Steud., and *Poa bigelovii* Vasey and Scribn.

Plants were growing in soil from limestone parent material where the limestone rock contained chert. The plants were frequently found growing in crevices of limestone cliffs or on relatively steep slopes. Two locations had vigorously growing plants in deep soil rather than crevices of rock. The range of flowering dates was from April 21 to June 15.

Chromosome smears were made for the *Bearden & Hatch* 202 and 204 populations. The chromosomes were difficult to count, and therefore, eight smears were made per population. These counts were all $2n = 44$. This is the first report for this species. Meiotic chromosome divisions were regular with only bivalent pairing occurring in Prophase I.

Table 1. Distribution Records for *Stipa curvifolia*; ²New record for Mexico; ³New county records for New Mexico; ⁴New state record for Texas.

MEXICO. CHIHUAHUA: Sierra San Martin d. Borracho, steep N facing slopes in calcareous soils, 15 Jun 1973, *Johnston, Wendt & Chiang 1139 F²* (TEX).

UNITED STATES. NEW MEXICO: DONA ANA CO.: 6 km SE of Las Cruces on "A" Mountain, N & NE facing slopes, 10 May 1979, *Bearden & Hatch 205³* (NMC, TAES); 32 km SE of New Mexico State University, 3.5 km E of Bishops Cap in the Organ Mts., 2 May 1979, *Bearden & Hatch 204³* (NMC, TAES). EDDY CO.: Guadalupe Mts., mouth of North Fork of Rocky Arroyo, 21 Apr 1979, *Bearden & Hatch 201* (NMC, TAES); 2 km W of the mouth of North Fork of Rocky Arroyo, 21 Apr 1979, *Bearden & Hatch 202* (NMC, TAES); Last Chance Canyon, 21 Apr 1979, *Bearden & Hatch 203* (NMC, TAES). TEXAS: HUDSPETH CO.: Guadalupe Mts., 40 m E of streambed and SW of Cutoff Peak, 1.4 km SW of the summit of Cutoff Peak, 27 Apr 1975, *Burgess 3220⁴* (LL, TEX).

Pollen fertility was relatively high with the four populations (*Bearden & Hatch 202, 203, 204, & 205*) having 82-91 percent stainable pollen. This was expected since there were no major irregularities in meiosis.

There were no significant differences in germination percentages between the caryopses given a cold treatment and those not treated with low temperatures. Ninety-three percent of the caryopses given the cold treatment germinated while 92 percent of the caryopses without a cold treatment germinated. Caryopses stored in the laboratory for a four-year period were found to have germination percentages of about 10 percent.

CONCLUSIONS

Stipa curvifolia is rare in the mountains of the Chihuahuan Desert but not endangered. There are no current activities of man that appear to endanger the existence of this species. Cattle grazing does not have a great effect on the species because cattle seldom graze steep rocky slopes or cliffs of this habitat. This species is likely to occur in several other locations that have not been carefully collected. Early spring flowering is probably a major reason that this species has not been collected to a greater extent.

Factors limiting the distribution of this species are more a scarcity of habitat rather than the reproductive capabilities of the plant. Regular chromosome divisions, high pollen fertility and high germination all indicate good reproductive capabilities for *S. curvifolia*. Therefore, the relative scarcity of habitat and the great distance between locations is expected to limit this species distribution.

Because this species is restricted to cooler north facing slopes and crevices of limestone rock or soils derived from limestone, it is postulated that *S. curvifolia* is a remnant species from a flora that existed when temperatures were cooler and more moisture was available.

REFERENCES

- BEETLE, A. A. 1977. Noteworthy grasses from Mexico V. *Phytologia*. 37:317–408.
- CHASE, A. 1951. Revision of Hitchcock's manual of the grasses of the United States, 2nd ed. U.S.D.A. Misc. Publ. 200. 1051 p.
- CORRELL, D. S. and M. C. JOHNSTON. 1970. Manual of the vascular plants of Texas. Texas Research Foundation. 1881 p.
- GOULD, F. W. 1951. Grasses of southwestern United States. The Univ. of Arizona Press, Tucson. 353 p.
- . 1975. The grasses of Texas. Texas A & M Univ. Press. College Station. 653 p.
- HAUSER, E. J. P. and J. H. MORRISON. 1964. The cytological reduction of nitro blue tetrazolium as an index of pollen viability. *Amer. J. Bot.* 51:748–752.
- HITCHCOCK, A. S. 1935. Manual of the grasses of the United States. U.S.D.A. Misc. Publ. 200. 1040 p.
- MARTIN, W. C. and C. R. HUTCHINS. 1980. A flora of New Mexico. J. Cramer, A. R. Gantner Verlag K. G.
- SMITH, L. 1947. The acetocarmine smear technique. *Stain Tech.* 17:31.
- SWALLEN, J. R. 1933. New grasses from the United States, Mexico and Central America. *J. Wash. Acad. Sci.* 23:456–460.

NOTES

TWO ADDITIONS TO THE ARKANSAS FLORA FROM WARREN PRAIRIE—Botanical collecting trips to Warren Prairie in southeast Arkansas (Bradley and Drew counties) have yielded two new state records from an area already considered remarkable for its unusual flora. A number of prairie disjuncts that are rare or absent otherwise in the state previously have been reported from this saline soil prairie. The most interesting are *Geocarpon minimum* Mackenzie (Caryophyllaceae), *Evolvulus sericeus* Sw. (Convolvulaceae), *Krigia occidentalis* Nutt. (Compositae), *Schoenolirion wrightii* Sherman (= *S. texanum* (Scheele) Gray, Liliaceae), and *Anthaenantia rufa* (Ell.) Schult. (Gramineae). All five are common on the prairie. For literature citations and more information on geographic distribution see Smith (Atlas and annotated list of the vascular plants of Arkansas. 1978. University of Arkansas Bookstore, Fayetteville). Soil surveys of Bradley and Drew Counties (United States Department of Agriculture, Soil Conservation Service, 1961 and 1976, respectively) classify Warren Prairie soils in the Lefe Series (Glossic Natrudalfs), characterized by concretions of calcium carbonate throughout the profile and by high levels of sodium and magnesium. The vegetation is savanna. Forbs and grasses of the prairie glades are interrupted by circular mounds, 50 to 100 feet in diameter and 3 to 4 feet high, covered with stunted pine, post and blackjack oak, and a variety of shrubs. To insure preservation of Warren Prairie and its unique plant life, the Arkansas Natural Heritage Commission recently (1982) has purchased a block of 304 acres in Bradley County including the largest and best developed of the prairie glades.

Voucher specimens of the species cited below are deposited in the University of Arkansas at Monticello Herbarium. I would like to thank Dr. Edwin B. Smith of the University of Arkansas at Fayetteville for confirmation of my determinations.

ASTER PRATENSIS Raf. Bradley Co.: Warren Prairie, occasional in open prairie among prickly-pear (*Opuntia compressa*) and dwarf palmetto (*Sabal minor*), 15 mi W of Monticello, 2 Oct 1982, *Sundell & McIntyre* 2904; Drew Co.: (no further locality cited), 29 Oct 1972, *Lavender* 34. The species is previously known only from Louisiana and eastern and north central Texas.

SPOROBOLUS JUNCUS (Michaux) Kunth. Pinewoods dropseed. Drew Co.: Warren Prairie, open woods on mound beside wetland prairie, ca 14 mi W of Monticello, 9 Oct 1982, *Sundell & McIntyre* 2926. This taxon is a coastal plain element from Virginia to Florida and Texas and not unexpected in southern Arkansas. Allen (Grasses of Louisiana. 1980. University of Southwestern Louisiana, Lafayette) maps collections from Caddo and Clai-

borne parishes in northwestern and north central Louisiana.—*Eric Sundell, Department of Natural Sciences, University of Arkansas at Monticello, Monticello, AR 71655.*

CYPRIPEDIUM CANDIDUM MUHL. EX WILLD. (ORCHIDACEAE) IN ARKANSAS—A report from a former student (P. Thompson) in my plant taxonomy course prompted me and some present graduate students to examine a small patch of an orchid in Benton County, Arkansas in May, 1983. The patch was originally discovered by (Mrs.) Lee Sowers. Much to our surprise, we found the plants to be a new state record, *Cypripedium candidum* Muhl. ex Willd., the "small white lady's-slipper." The patch consisted of a clump of only four stems, probably all from the same rootstock, growing on the floodplain of a small creek in Bella Vista, Arkansas. The exact locality is being withheld to enhance the probability of survival of the rare species in Arkansas. Fernald (1950) and Steyermark (1973) noted the rarity of *C. candidum*. The previously reported range of the species is more northern, extending through much of the northeastern quarter of the United States, extreme southern Ontario and extreme southern Manitoba (cf. Plate 6 in Luer, 1975; Magrath, 1973; Ettman & McAdoo, 1979). The Benton County population is evidently the southern-most known population of *C. candidum*. Voucher specimen: *S. L. Timme 2434* (UARK).—*Edwin B. Smith, Department of Botany & Microbiology, University of Arkansas, Fayetteville, AR 72701.*

REFERENCES

- ETTMAN, J. K. and D. R. McADOO. 1979. An annotated catalog and distribution account of the Kentucky Orchidaceae. The Kent. Soc. of Nat. Hist. Charit. Trust, Louisville, Kent.
- FERNALD, M. L. 1950. Gray's manual of botany. 8th ed. American Book Co., N.Y.
- LUER, C. A. 1975. The native orchids of the United States and Canada excluding Florida. New York Bot. Gard., Bronx, N.Y.
- MAGRATH, L. K. 1973. The native orchids of the prairies and plains region of North America. Ph.D. Diss., Dept. Botany, U. of Kansas, Lawrence.
- STEYERMARK, J. A. 1963. Flora of Missouri. Iowa State U. Press, Ames.

MURDANNIA KEISAK (HASSK.) HAND.-MAZZ. (COMMELINACEAE), *BOTHRIOCHLOA HYBRIDA* (GOULD) GOULD (POACEAE), AND *SCUTELLARIA RACEMOSA* PERS. (LAMIACEAE) NEW TO LOUISIANA—Field work on a flora of Allen Parish, Louisiana, has produced three unreported taxa for the state. This flora project is supported by a grant from Louisiana State University at Eunice.

MURDANNIA KEISAK (Hassk.) Hand.-Mazz. (*Aneilema keisak* Hassk.). LOUISIANA. Allen Parish: infrequent in roadside ditch off U.S. 165 ca 1.6

mi S of Kinder, *Allen 11327*, 19 Sep 1981. This species is native to southeastern Asia; the range other than Louisiana in the United States is from southeastern Virginia to northern Florida (Godfrey & Wooten, 1975). Duplicates are being sent to LAF, LSU, and NLU.

BOTHRIOCHLOA HYBRIDA (Gould) Gould (*Andropogon hybrida* Gould). LOUISIANA. Allen Parish: infrequent in pine forest on dry sandy soil between railroad and U.S. 190 ca 4 mi W of Kinder, *Allen 11187*, 25 Jul 1981. The range of this grass other than Louisiana is south-central Texas and northern Mexico (Gould, 1975). Dr. Steven Hatch of Texas A&M University kindly verified a duplicate specimen. Duplicates are also being sent to LAF, LSU, and NLU.

SCUTELLARIA RACEMOSA Pers. LOUISIANA. Allen Parish: infrequent in pine forest off U.S. 164 ca 2 mi N of Oberlin, *Allen 11947*, 6 May 1982. This recent introduction into the United States from South America has also been found in the coastal plain of South Carolina, Florida Panhandle, southwestern Georgia, and southeastern Alabama. (Godfrey and Wooten, 1981). Duplicates are being sent to LAF and NLU.—*Charles M. Allen, Division of Sciences, Louisiana State University at Eunice, Eunice, LA 70535.*

REFERENCES

- GODFREY, R. K. and J. W. WOOTEN. 1979. Aquatic and wetland plants of southeastern United States. Monocotyledons. University of Georgia Press, Athens.
 ———. 1981. Aquatic and wetland plants of southeastern United States. Dicotyledons. University of Georgia Press, Athens.
 GOULD, F. W. 1975. The grasses of Texas. Texas A&M Univ. Press, College Station.

CYPERACEAE NEW TO TEXAS AND LOUISIANA—**ELEOCHARIS VIVIPARA** Link, a cespitose perennial with thin rhizomes, inhabits ditches, depressions, borders of swamps and marshes, and wet clearings. It is frequently confused with *E. montevidensis* Kunth and *E. verrucosa* (Svens.) Harms (*E. tenuis* (Willd.) Schultes var. *verrucosa* (Svens.) Svens.), but can be distinguished from them by its conic-pyramidal tubercle, castaneous basal sheaths, filiform rhizomes, and the presence of viviparous spikelets. It has been previously reported from Virginia south to Florida and west to Mississippi (Radford, et al., 1968; Long and Lakela, 1971; Godfrey and Wooten, 1979). A specimen of *E. vivipara*, new to Texas, was collected in Robertson County: roadside depression on N side of Hwy. 79 ca 0.5 to 1 mi W of the Navasota River, 13 Jun 1982, *Starbuck 2373* (TAMU).

SCLERIA LITHOSPERMA (L.) Sw. has been previously reported from Florida, the Bahama Islands, the West Indies, Mexico, Central and South America, and most tropical regions of Europe, Africa, and Asia (Core, 1936; Long

and Lakela, 1971; Godfrey and Wooten, 1979). Two specimens of *S. lithosperma*, new to Louisiana, have been collected on opposite sides of the state. The collection data are: St. Tammany Parish: open fields in swampy area S of US 190, E of La. 25, N of Covington, Sec. 45T6SR11E, 2 Jun 1976, *Thomas 49285* (NLU); and Sabine Parish: open areas, field and edge of woods, SE of La. 473 at Beaver Creek, NE of Toro, Sec. 46T4NR12W, 7 Jun 1980, *Thomas 71511* (NLU).—James W. Kessler, Tracy Herbarium, Range Science Dept., Texas A&M University, College Station, TX 77843; Tom Starbuck, Biology Dept., Texas A&M University, College Station, TX 77843.

REFERENCES

- CORE, E. L. 1936. The American species of *Scleria*. *Brittonia* 2:1–105.
 GODFREY, R. K. and J. W. WOTTEN. 1979. Aquatic and wetland plants of southeastern United States, Monocotyledons. The University of Georgia Press, Athens.
 LONG, R. W. and O. LAKELA. 1971. A flora of tropical Florida. The University of Miami Press, Coral Gables, Florida.
 RADFORD, A. E., H. E. AHLES, and C. R. BELL. 1968. Manual of the vascular flora of the Carolinas. The University of North Carolina Press, Chapel Hill.

PANICUM SPHAEROCARPON ELL. VAR. *POLYANTHES* (SCHULTES) A. S. SHERIF (POACEAE) COMB. NOV.—Hitchcock and Chase (1910) proposed the subgenus *Dichanthelium* of the genus *Panicum*. Gould (1974) reduced *P. polyanthes* to a variety of *Dichanthelium*. I prefer to maintain the original circumscription of the genus *Panicum* sen. lat.

PANICUM SPHAEROCARPON Ell. var. *POLYANTHES* (Schultes) A. S. Sherif comb. nov.

Panicum polyanthes Schultes, Mant. 2:257. 1824.

Dichanthelium sphaerocarpon (Ell.) Gould var. *polyanthes* (Schultes) Gould, *Brittonia* 26:60. 1974.

—A. S. Sherif, Department of Botany and Microbiology, University of Arkansas, Fayetteville, AR 72701.

THE ROLE OF PLANT SUCCESSION IN THE EXTINCTION OF PLANT SPECIES—Species occurring in the lower seral stages of plant succession are not apt to become extinct. However, endemic species of rare occurrence in the climax stage of the site or polyclimax concept are the taxa most susceptible to reduction in population numbers and with catastrophic events or man's activity are apt to become extinct. Wm. F. Mahler, Herbarium, Southern Methodist University, Dallas, TX 75275.

CORRECTION

The holotype of *Conyza chiapensis* Brandg. (*Purpus* 8987) is not housed at US, as reported by me (*Sida* 10(1):30–32. 1983.), but at UC.

REVIEW

ACTA BOTANICA ACADEMIAE SCIENTIARUM HUNGARICAE, Volume 27, numbers 3–4, 1981, pp. 281–476. (Fifteen papers, 5 of particular interest to Systematic Botanists. Xylotomic examination of some Venezuelan *Capparis* species, I. K. Babos, I. R. Bermudez, L. J. C. Cumana—Studies in Rondeletieae (Rubiaceae) I. A new genus: *Roigella*, A. Borhidi, M. Z. Fernandez—Studies in Rondeletieae (Rubiaceae) II. A new genus: *Suberanthus*, A. Borhidi, M. Z. Fernandez—A new fiddle-wood from Cuba: *Citharexylum matheanum* sp. n., A. Borhidi, Z. Kereszty—Palmas nuevas del género *Coccothrinax* Sarg. en Cuba, O. Muñiz and A. Borhidi).

Volume 28, numbers 1–2, 1982, pp. 1–290. (Sixteen papers. Xylotomic examination of some Venezuelan *Capparis* species, II, K. Babos, I. R. Bermudez, and L. J. C. Cumana—East African Bryophytes, V, M. Bizot and T. Pócos—Studies in Rondeletieae (Rubiaceae) III. The genera *Rogiera* and *Arachnothryx*, A. Borhidi—Rubiaceas cubanas II-III, M. Z. Fernandez and A. Borhidi—El género *Diplasiolejeunea* en Cuba, D. M. Reyes—Anatomia de la madera de Myricaceae en Cuba; Consideraciones ecológicas, M. Vales, A. Borhidi and E. Del-Risco).

Volume 28, numbers 3–4, 1982, pp. 291–454. (Nine papers. Catálogo de las palmas de Cuba, O. Muñiz and A. Borhidi—East African bryophytes, VI, R. Ochyra and T. Pócs—Pollination biological characteristics of various *Malus* taxa, M. Soltész, M. Tóth, F. Gyuró, A. Terpó, and J. Nyéki).

IN MEMORIAM

With the death on August 28, 1983 of Samuel Wood Geiser, Professor *Emeritus* of Biology, the University lost a faculty member of long service and great dedication. Dr. Geiser joined the faculty of the Department of Biology in 1924 and served until his retirement in 1957, for twenty-seven of those thirty-three years as chairperson of the Department.

Professor Geiser was a scholar, educated in the classical tradition, a student of literature and languages (Latin, Greek, German, French, Russian, and others) as well as biology. His great love was the history of science, and the better part of his scholarly work was devoted to the investigation of the activities of the early naturalists (and other scientists) of the South and Southwest.

During the 1930s and 1940s, when heavy teaching loads were common-

place for faculty, Dr. Geiser never lost sight of the importance of scholarly work and was one of those who kept alive the spirit of scholarly activity and research on campus during this difficult period. Working into the wee hours of the morning, he pursued the exploits of his beloved naturalists, recording his findings on the backs of used cards which he begged from the librarians and the registrar. Funds for research activities were difficult to obtain in those days, and it is safe to say that not an insignificant amount of his salary was spent on his investigations.

Professor Geiser found the time to edit for more than 15 years (and to provide considerable copy for) a University publication in the sciences *Field and Laboratory*. He, himself, authored over 200 publications, among them, in 1937, his best known work, *Naturalists of the Frontier*, the first book published by the S.M.U. Press.

Sam Geiser was one of those people whose great dedication to S.M.U. during her formative and difficult years helped to guide the institution toward maturity.

—Extracted from the *PROVOST'S LETTER*, Southern Methodist University, September, 1983, Dr. Hans J. Hillerbrand, Provost.

REVIEWERS FOR VOLUME 9 OF *SIDA*

The following individuals kindly provided time and energy in reviewing manuscripts published in *Sida*.

Lincoln Constance
Donovan S. Correll
Thomas B. Croat
Arthur Cronquist
H. R. DeSelm
Paul Fryxell
Alwyn H. Gentry
Shirley A. Graham
Charles R. Gunn
Stephan L. Hatch
Robert R. Haynes
Robert S. Irving
Fred B. Jones

Robert Kral
Cheryl A. Lawson
Paul H. Monson
Guy L. Nesom
R. W. Pohl
A. Michael Powell
Chester M. Rowell
Edwin B. Smith
Ronald L. Stuckey
A. Spencer Tomb
Gary Tucker
Daniel B. Ward

Wm. F. Mahler, Publisher
Barney L. Lipscomb, Editor
John W. Thieret, Associate Editor

SIDA CONTRIBUTIONS TO BOTANY

VOLUME 10

NUMBER 3

JUNE 1984

CONTENTS

- A new species of *Nymphaea* (Nymphaeaceae) from the Amazon basin. *John H. Wiersema*. 195
- Nomenclatorial changes, lectotypification, and comments in *Aronia medikus* (Rosaceae). *Leonard J. Uttal*. 199
- A new species of *Rhodopis* (Fabaceae) from Hispaniola. *Walter S. Judd*. 203
- Opuntia heacockae* (Cactaceae) a new species from central Colorado. *Gerald K. Arp*. 207
- Selaginella gypsophila* (Selaginellaceae), yet another new edaphic endemic from northern Mexico. *Alan R. Smith and Timothy Reeves*. 211
- Senecio millefolium* T. & G. (Asteraceae) and its introgressants. *Leonard J. Uttal*. 216
- Solidago* (Asteraceae) in Oklahoma and Texas. *Constance E. S. Taylor and R. John Taylor*. 223

NOTES. The Demoulin Rule in nomenclature. 252—*Ipomoea dumetorum* (Convolvulaceae): an amphitropical disjunct morning glory in the southwest U.S. 252.—Cleistogamy in *Muhlenbergia cuspidata* (Poaceae). 254—*Carya pallida* (Ashe) Engl. & Graebn. (Juglandaceae), a new Arkansas record. 255—*Stylisma pickeringii* var. *pattersonii* (Fern. & Schub.) Myint (Convolvulaceae) rediscovered in Iowa. 256—*Bromus sterilis* L. (Poaceae) new to Texas. 257—*Cyperus ovularis* (Michx.) Torr. var. *cylindricus* (Ell.) Torr. (Cyperaceae) new to New Mexico. 258—*Arnoglossum sulcatum* (Asteraceae) in Mississippi. 258—New grass (Poaceae) distribution records for Mexico. 259—*Echinodorus tenellus* var. *parvulus* (Alismataceae) in Kentucky. 262—*Carex rosea* (Cyperaceae), *Trifolium lappaceum* (Fabaceae) and *Aira caryophyllea* (Poaceae) new to Texas. 263.

IN MEMORIAM

265

US ISSN 0036-1488

SIDA, CONTRIBUTIONS TO BOTANY

Founded by Lloyd H. Shinnars, 1962

Publisher

Wm. F. Mahler
SMU Herbarium
Dallas, Texas, 75275

Associate Editor

John W. Thieret
Northern Kentucky University
Highland Heights, Kentucky, 41076

Editor

Barney L. Lipscomb
SMU Herbarium
Dallas, Texas, 75275

Guidelines for contributors are available upon request.

Subscription: \$10.00 (U.S.) per year; numbers issued twice a year.



Sida, Contributions to Botany, Volume 10, Number 3, pages 195–267.

Copyright 1984
by Wm. F. Mahler

A NEW SPECIES OF NYMPHAEA (NYMPHAEACEAE) FROM THE AMAZON BASIN

JOHN H. WIERSEMA

*Department of Biology, University of Alabama,
University, AL 35486*

ABSTRACT

A night-blooming, sagittate-leaved water-lily of *Nymphaea* subgenus *Hydrocallis* is described from the Amazon drainage in northern Brazil.

During the course of research involving the neotropical *Nymphaea* subgenus *Hydrocallis*, several undescribed species have come to my attention. The subgenus is characterized by nocturnal flowering habit, tetrameric arrangement of outer flower parts, and clavate carpellary appendages. Four of these new taxa are described in a separate publication (Wiersema, 1984). A fifth has since been discovered and is described below.

NYMPHAEA POTAMOPHILA Wiersema, sp. nov. (Fig. 1).

Folia plerumque variegata rubicunda, elliptico-sagittata, in siccis speciminibus punctis elevatis ex trichosclereidibus interioribus ornata, sclereidibus acicularibus interioribus nullis; processus carpellorum 7–9 mm longi; radii stigmatum sclereidibus acicularibus nullis.

Rhizome not seen. Leaf blades chartaceous, elliptic-sagittate, to 20 cm or more long, to 10 cm or more wide, ca 1.8–2.5 times as long as wide, entire, acute-tapering to somewhat rounded at apex, peltate 1–2 mm from base of sinus, the sinus 0.53–0.62 times length of blade, sagittate at base, the lobes acute-tapering; upper surface green, often strongly variegated with red, when dried with numerous tiny prominences from underlying trichosclereids, lacking acicular or filiform sclereids; undersurface greenish to variegated with dark red, usually marked with slender, branched rusty-brown lines when dried; venation radiate centrally, scarcely evident toward margins, the principal veins 7–11, somewhat impressed. Petioles to 3 mm in diam., elongating to 4 m or more, glabrous. Peduncles to 4 mm in diam., elongating to 4 m or more, glabrous. Flowers floating, the sepals, petals, and outer stamens in distinct whorls of four; sepals green, oblong-ovate, ca 4–5 cm long, ca 1.5–2.0 cm wide, acute at apex, when dry usually marked with slender brownish or blackish lines, with few to numerous acicular sclereids, inconspicuously nerved; petals ca 16, impregnated with acicular sclereids, the outer greenish abaxially, slightly shorter and often narrower than sepals,

with apex acute, the inner becoming creamy-white, ca 2.5–3.7 cm long, ca 0.8–1.2 cm wide, acuminate; transition to stamens gradual; stamens ca 40–60, creamy-white, impregnated with abundant acicular sclereids, the outermost to 3 cm long, with filaments to 8 mm wide, the inner with filaments to 1.4 mm wide and connectives prolonged to 0.2 mm beyond anthers, the inner anthers 0.5–0.6 times as long as stamen; carpels ca 19–21, the appendages cream-colored, ca 7–9 mm long, clavate, the enlarged tips ca 3 mm long, ca 1–1.2 mm in diam., with blunt apex, the stigmatic rays lacking acicular sclereids, the papillae cells remaining attached. Fruits usually present, seeds 0.85–1.3 mm long, 0.7–1 mm wide, 1.1–1.3 times as long as wide, with clusters of hairs 45–210 μm long, the fine surface topography smooth. Pollen diameter 25–35 μm .

TYPE: BRAZIL. AMAZONAS: Rio Negro acima do lugar São Luis, pouco acima de Barcelos, 28 Jun 1979, *L. A. Maia, E. Soares, J. Ramos, and C. D. Mota* 124 (INPA!).

Additional specimens examined. BRAZIL. AMAZONAS: Rio Negro, Padauriy, Telheiro, 30 Oct 1947, *Fróes* 22686 (IAN); Rio Negro, Parana Ararirá, ca 100 km above Barcelos, 11 Oct 1978, *Madison et al.* 6155 (SEL, NY). PARÁ: São Francisco do Cururú Mission, boca de Igarapé Kenebiit-Taibiri para o Rio Cururú, 31 Mar 1942, *Sioli* 4 (IAN).

DISTRIBUTION. Known only from the states of Amazonas and Pará in northern Brazil. Most collections are from river margins, with the long petioles and peduncles and collection data present on specimens indicating *N. potamophila* can survive in water as much as 4–5 m deep.

REPRODUCTION. Both pollen viability and seed set in this species appear to be high, as judged from the limited amount of herbarium material available. Clearly, seed production is an important means of dispersion in this taxon. No evidence is presently available to determine whether autogamy contributes to seed production.

RELATIONSHIPS. *Nymphaea potamophila*, on the basis of seed morphology and overall morphology, can be grouped with *N. blanda* G. F. W. Mey. and *N. oxypetala* Planch. Flowers of *N. potamophila* are similar to those of *N. blanda*, the latter having longer carpellary appendages and more numerous acicular sclereids in the sepals. The floating sagittate leaves of *N. potamophila* are reminiscent of *N. oxypetala* which has sagittate submersed leaves, but floating sagittate leaves of the latter species are reduced both in number and size. The poorly known *N. belophylla* Trickett, for which type material is missing at both K and BM, possesses sagittate floating leaves resembling those of *N. potamophila*. Flowers of *N. belophylla*, as described by Trickett (1971), appear to have carpellary appendages approaching twice the length of those in *N. potamophila*. A plant relatable to *N. belophylla*, collected by Baltazar Trujillo in Barinas, Venezuela, indeed displays these longer carpellary appendages. This plant is further distinguished in an abundance of acicular sclereids in the leaf and stigmatic ray tissues, where these structures are completely absent in *N. potamophila*. If this Venezuelan plant is in

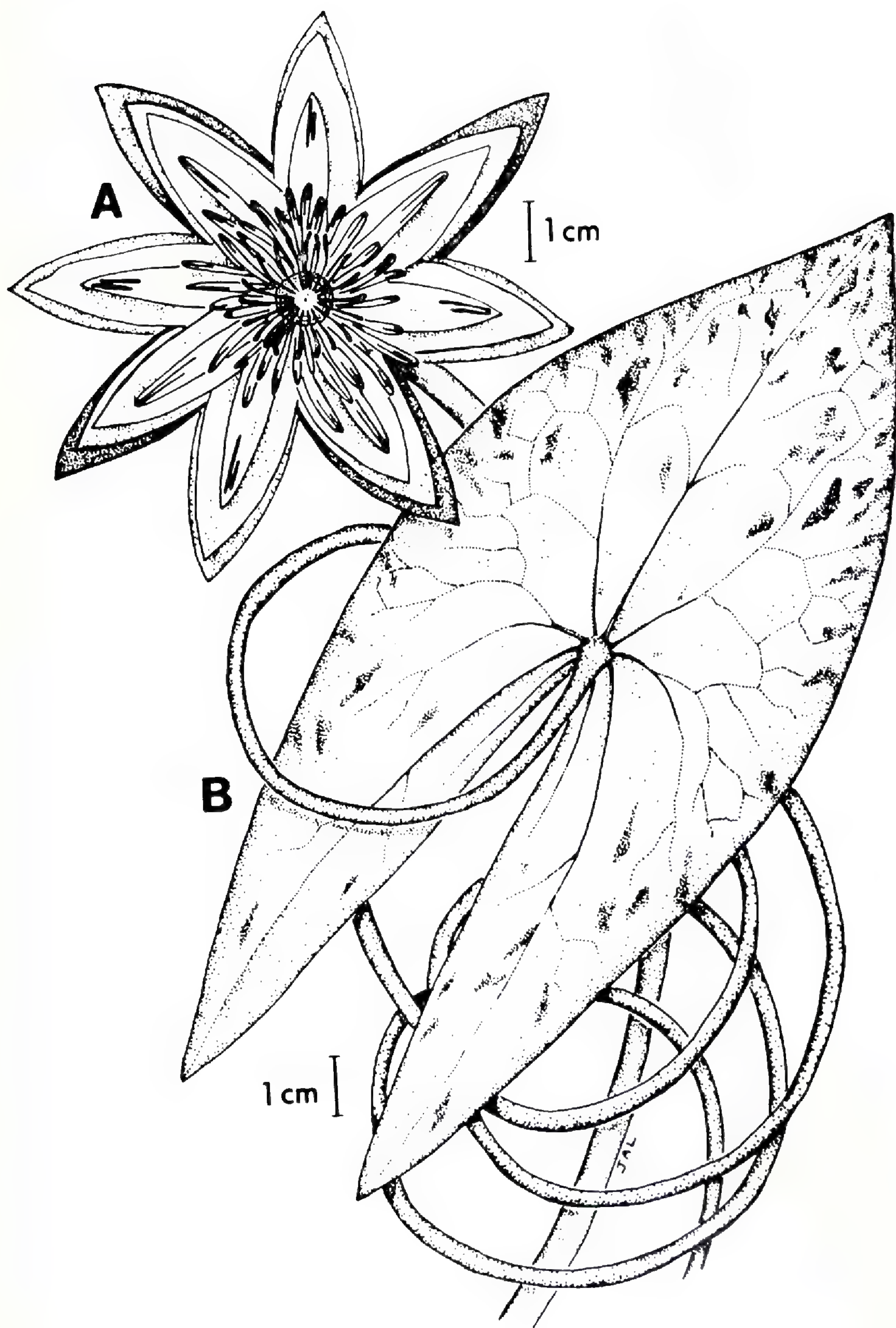


Fig. 1. *Nymphaea potamophila*: (A) open flower (B) undersurface of leaf.

fact *N. belophylla*, its observed character differences support its taxonomic separation from *N. potamophila*, in view of the conservative nature of these characters among other *N.* subg. *Hydrocallis*. Accordingly, the two taxa have been segregated at the rank of species. However, additional collection and study of these taxa in the South American interior are clearly necessary to provide a better understanding of their relationship.

REFERENCES

- TRICKETT, R. S. 1971. A new tropical American waterlily, *Nymphaea belophylla*. Kew Bull. 26(1): 29–31.
- WIERSEMA, J. H. 1984. Systematics of *Nymphaea* subgenus *Hydrocallis* (Nymphaeaceae). I. Four new species from the neotropics. Brittonia 36: (in press).

NOMENCLATORIAL CHANGES, LECTOTYPIFICATION, AND COMMENTS IN *ARONIA* MEDIKUS (ROSACEAE)

LEONARD J. UTTAL

*Biology Department, Virginia Polytechnic Institute
and State University, Blacksburg, VA 24061*

ABSTRACT

Aronia arbutifolia (L.) Elliott var. *glabra* Elliott is reduced to *forma*. A lectotype is designated for *A. melanocarpa* (Michaux) Elliott. *A. prunifolia* (Marshall) Rehder is formally designated a hybrid and the taxonomic consequence of this action is discussed.

In correcting the nomenclature of *Aronia arbutifolia* (L.) Elliott var. *glabra* Elliott, this author (1983) followed the prevailing practice of not recognizing this variety taxonomically. Since then, I have come to believe that the occasional short-stemmed Red Chokeberries with promptly glabrous leaves, peduncles, hypanthia, inner calyx, and young twigs, which occur in sand near the Atlantic coast from southern New Jersey to north Florida, are too manifestly different from the usual copiously pubescent Red Chokeberry to be dismissed as just another variant in a highly plastic species. Present descriptions of *A. arbutifolia* (L.) Elliott are rendered clumsy by obligatory tag-phrases to account for glabrous populations in an essentially pubescent species. Precise keys are difficult to construct. Failure to recognize the glabrous Red Chokeberries as an entity abets a continuing proclivity for some to confuse the glabrous northern Black Chokeberry, *A. melanocarpa* (Michaux) Elliott, with glabrous Red Chokeberries, resulting in persisting reporting of Black Chokeberries outside their natural range.

It is difficult to maintain the glabrous Red Chokeberries as a variety due to a pattern of continuous intergradation with the pubescent majority of plants. Still one is left with a residuum of promptly glabrous plants which are not servile to the majority of pubescent phenotypes. Intermediates may be clinal; they may represent introgression between the phenotypes, or both. No one really knows at this time. Such intermediates, when not in fruit, could be confused with *A. prunifolia* (Marshall) Rehder.

A suggested resolution to this problem is to consider the promptly glabrous plants as a *forma*:

ARONIA ARBUTIFOLIA (L.) Elliott *forma glabra* (Elliott) Uttal comb. et
stat. nov.

Aronia arbutifolia var. *glabra* Elliott, Sketch Bot. S. Carolina. I: 557. 1821. Including *Pyrus arbutifolia* var. *glabra* Cronquist, Castanea 14: 101-102. 1949, a superfluous name requiring recombination if maintained.

This *forma* is rare northward and most frequent from coastal North Carolina to Georgia.

Cronquist (1949) associates an inconsistent wand-like habit with this entity. I find the wand-like habit occasional in both glabrous and pubescent plants, growing in coastal and subcoastal open sands and the gravel of railroad banks. It seems to be purely an edaphic phase, the short stiff stems emanating from aggressive pioneer rhizomes. Branches of the virgate stems are aborted and spur-like. It is not known if virgate clones are independent or are adventitious from normal well-branched core colonies.

There should be no problem distinguishing non-fruiting *A. arbutifolia* f. *glabra* from *A. melanocarpa*:

Leaves dull green, turning red in fall, veinlets obscure. Herbarium material: some leaves anthocyanic. Aggressively rhizomatose, in sand and gravel, often virgate; southeastern United States coastal region.

..... *A. arbutifolia* f. *glabra*
Leaves bright green, never turning red in fall, veinlets conspicuous.
Herbarium material: leaves always green. Cespitose, in rocky or damp upland soils, never virgate; not south of north Georgia mountains. ... *A. melanocarpa*

Hardin (1973) made a strong case for the hybrid origin of *A. prunifolia* (*A. arbutifolia* X *melanocarpa*), both ancient and current, and laid to rest earlier objections to this hypothesis. He did not choose to formalize this hybrid but rather to formally recognize only the parental species. On the grounds that fruit color is the only reliable basis for separating chokeberry species, he included *A. prunifolia* with *A. melanocarpa* for purposes of identification. This union is unnatural and can not be sustained. Before discussing the reasons, it is necessary to designate a lectotype for *A. melanocarpa*, there being three sheets in the Michaux herbarium bearing elements of this species:

ARONIA MELANOCARPA (Michaux) Elliott, Sketch Bot. S. Carolina I: 556. 1821.

Pyrus melanocarpa (Michaux) Willdenow, Enum. Pl. Hort. Berol. 525 (1809).

Sorbus melanocarpa (Michaux) Heynhold, Nom. Bot. Hort: 773 (1840).

Mespilus arbutifolia var. *melanocarpa* Michaux, Fl. bor.-amer. 592. 1803. Basionym.

LECTOTYPE (here designated): "*Mespilus arbutifolia* fructu nigro, Tres Hautes Montagnes de la Carolina Septentrionale et Canada; aussi Connecticut, Boston etc." Auxillary label: "*Mespilus arbutifolia* Amelanchier d'Ameri. fruit noir. Canada Mistassin et Quebec." (LECTOTYPE: P, Herb. de l'Amerique Septentrionale d' André Michaux, IDC microfiche 6211. 65:III.6! Annotated "*Aronia melanocarpa*" by hand believed to be that of A. Gray).

Aronia prunifolia introgresses continuously with its presumed parents, *A. arbutifolia* and *A. melanocarpa*, and has been recognized as a hybrid (usually

with objection) a variety of either of the other two species, or, most usually, as a distinct species. Its leaves almost always have some pubescence on the under surface, if only restricted to the lower midrib and petiole. Early leaves are almost always pubescent. Peduncles may be partly pubescent or glabrous. The hypanthium is usually glabrous. Certain plants have very large, brilliantly lustrous purple-black pomes and lustrous pinkish twigs and red bud scales. Sterile shoots are sometimes very tall with exceptionally large leaves. Such plants may be F^1 's or close. The possibility of amphiploidy must be considered.

Aronia prunifolia, if a hybrid, according to Hardin (l.c.), maintains its phenotype by agamospermy and allogamy and has spread beyond parental sympatry. It is thus a viable entity. Even putative nothomorphs and backcrosses retain some pubescence. To include *A. prunifolia* with *A. melanocarpa* is discordant with the protologues of both entities.

If truly a hybrid, the inclusion of *A. prunifolia* with one of its parents is unnatural. The International Code (Art. H. 10) prescribes the use of the hybrid formula or name for all descendents, even to backcrosses.

Following the strong case for hybridity established by Hardin (l.c.), the author hereby formalizes it: *Aronia* $\times$ *prunifolia* (Marshall) Rehder (pro sp.) (*A. arbutifolia* $\times$ *melanocarpa*).

Though the boundaries between the parent species are obscured by introgression, in core localities they maintain their integrity and can usually be readily distinguished even when not fruiting. Candid intermediate plants are no problem; species descriptions often center on these. Marginal introgressants can be designated *A. x prunifolia* "complex".

While two entities of black vs. red Chokeberries is artificially facile and the designation of *A. prunifolia* as a hybrid results in a return to the necessity of designating enigmatic specimens, this is the philosophic nature of things for plants defy compartmentalization and the problem of dealing with introgressants is common enough.

The problems in *Aronia* remain in a primitive state of comprehension. From the standpoint of classical taxonomy, they will continue to defy finite resolution until better specimens are provided. Most extant specimens are insufficient. A collector should do his utmost to obtain both flowering and fruiting samples from the same plant. Root sampling is important. If it is impossible to obtain roots, describe them. Report if the specimen is from a vegetative clone or is cespitose. Root differences between the species is imperfectly known despite the statement in Radford *et al.* (1968) that red and purple chokeberries are rhizomatose while black ones are cespitose.

The following analysis of *Aronia* taxa is offered:

1. *A. arbutifolia* f. *arbutifolia*—Fruit dull to lustrous red, persisting into winter, even into spring. Colonial by rhizomes. Leaves dull green, densely tomentose on undersurface, the veinlets obscured, turning red in fall; on herbarium specimens, often anthocyanic. Peduncles, young twigs, hypanthia,

inner calyx, and, often, base of or entire pome pubescent. Stems often wand-like in coastal areas. Shrub, 1–3 m tall.

1a. *forma glabra*—leaves, peduncles, young twigs, hypanthia, inner calyx promptly glabrous. Usually less than 1 m tall.

2. *A. melanocarpa*—Fruit dull to barely lustrous black, promptly dropping when ripe. Reported to be nonrhizomatose. Leaves bright green, glabrous throughout or rarely with a few isolated hairs on undersurface, drying green in fall; on herbarium specimens, veinlets conspicuous. Peduncles, young twigs, hypanthia, inner calyx and fruit glabrous. Stems amply branched, never wand-like, 1–2 m tall, rarely to 3 m.

3. *A. x prunifolia*—Fruit purple-black to black, sometimes large and brilliantly lustrous, as are sometimes stems and bud-scales, but as often small and dull, persisting into winter or dropping early. Leaves usually lightly pubescent on undersurface to nearly glabrous when mature retaining some hairs on lower part of midrib and petiole, ranging from dull to bright green, turning red in fall or drying green, occasionally enormous (to 9 cm). Inner calyx villous. Peduncles usually pubescent at base to entirely glabrescent. Young twigs slightly pubescent to glabrous. Shrub, usually 1–2 m, vigorous sterile shoots to 3 m.

Specimens used in this study are in VPI. Field observations were made in Virginia, North Carolina, and Alabama.

ACKNOWLEDGMENTS

J. W. Hardin and D. M. Porter kindly consulted and advised me. The staff of VPI and Newman Library at Virginia Tech rendered exemplary service.

REFERENCES

- CRONQUIST, A. 1949. Noteworthy plants of Georgia. *Castanea* 14: 101–102.
 HARDIN, J. W. 1973. The enigmatic chokeberries (*Aronia*, Rosaceae). *Bull. Torrey Bot. Club* 100: 178–184.
 RADFORD, A. E., C. R. BELL, and H. E. AHLES. 1968. *Manual of the vascular flora of the Carolinas*. University of North Carolina, Chapel Hill.
 UTTAL, L. J. 1983. Additions to synonymy of *Aronia arbutifolia* (L.) Ell. *Castanea* 48: 317.

A NEW SPECIES OF *RHODOPIS* (FABACEAE) FROM HISPANIOLA¹

WALTER S. JUDD

*Department of Botany, University of Florida,
Gainesville, FL 32611*

The species described in this paper was discovered in the botanically little known Loma de la Sal, south of Jarabacoa in the Dominican Republic, and represents the second known species of *Rhodopis*. This genus, described by Urban (1900), is distinguished by its viny habit, unifoliolate leaves, racemose inflorescences with elongate peduncles, red flowers with all petals articulate and the banner the largest and most conspicuous, bilabiate calyx with united upper two lobes and very small lateral lobes, and linear, flat, pubescent legumes. The only previously described species, *R. planisiliqua* (L.) Urban, is a vine of montane regions in the Dominican Republic and Haiti (Barker & Dardeau, 1930; Moscoso, 1943). *Rhodopis* is closely related to the monotypic Puerto Rican genus *Neorudolphia* Britton (Britton & Wilson, 1924). Both are members of the tribe Phaseoleae, subtribe Erythrinae, and their bright red flowers, with a prominent, elongated, banner petal, are superficially similar to those of *Erythrina*. No other characters support a close association of *Rhodopis* and *Neorudolphia* with *Erythrina* (Lackey, 1981).

RHODOPIS LOWDENII Judd, sp. nov. (Figure 1)

Species haec ab *Rhodopis planisiliqua* (L.) Urban differt foliis crassioribus, bullatis, nervo primario, nervis secundariis et nervis tertiariis clare depressis in pagina adaxiali et conspicue elevatis reticulatis in pagina abaxiali, floribus minoribus, calycibus, inflorescentis cum pedunculis brevioribus.

Woody twining vine with glabrous to sparsely pilose twigs. Leaves alternate, unifoliolate; petioles 1–2.7 cm long, sparsely to moderately pilose, with prominent upper and lower pulvini, the former associated with 2 linear, 1.5–3 mm long stipels, and the latter with 2 narrowly triangular, 2–3 mm long stipules; leaflet ovate to nearly elliptic, 3.5–7 cm long, 2–4.2 cm wide, coriaceous, base slightly cordate to rounded, apex slightly to conspicuously acuminate, margin entire, slightly revolute, venation prominent and brochidodromous, with primary, secondary and often tertiary veins impressed on adaxial surface (leaflet thus $\pm$ bullate) and all veins clearly raised-reticulate on abaxial surface, indumentum pilose, i.e., of sparsely to moderately distributed straight, unicellular, nonglandular hairs, becoming nearly

¹ This paper is Florida Agricultural Experiment Station Journal Series No. 4980.

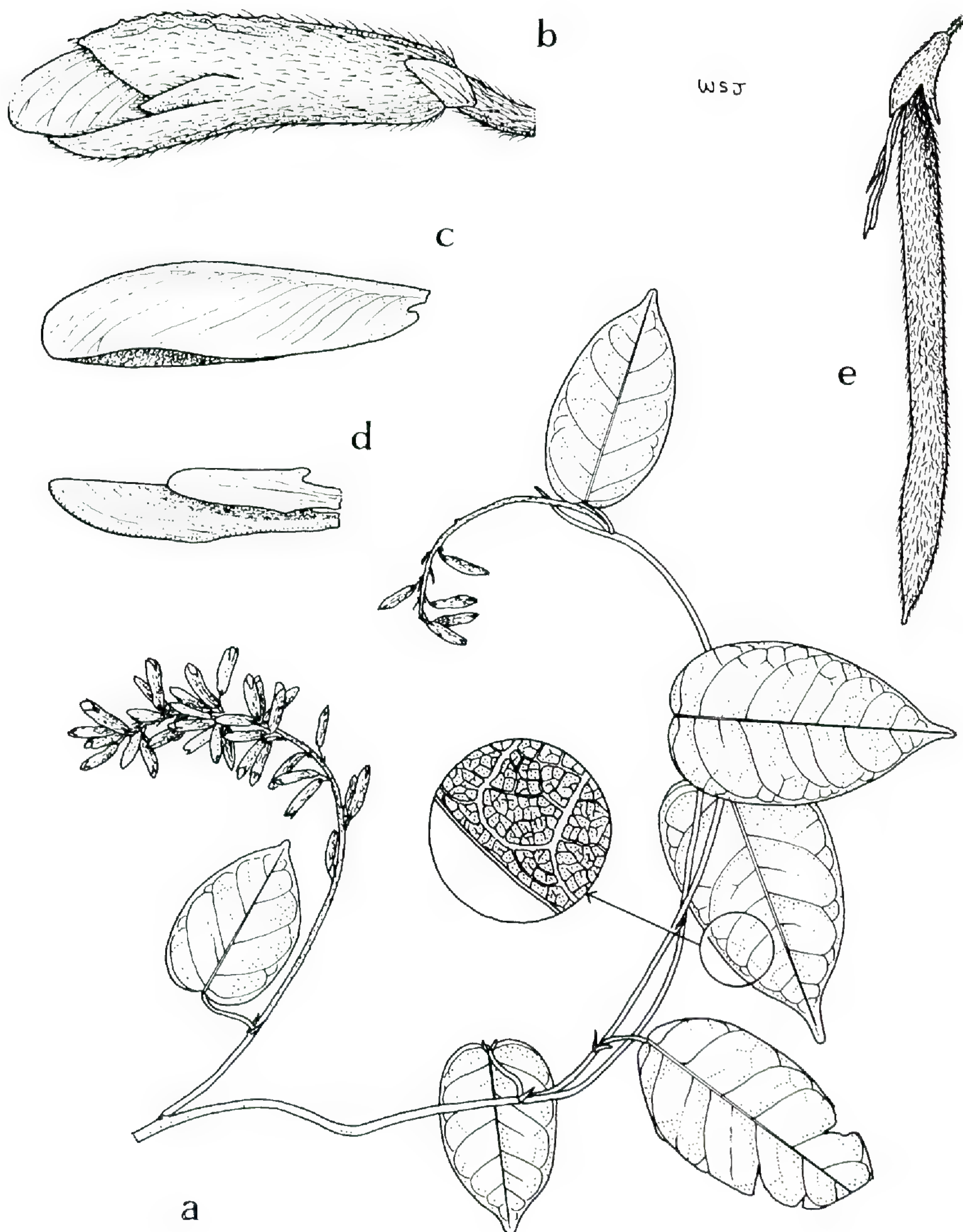


Figure 1. *Rhodopis lowdenii* Judd: a, habit, X .5; b, flower, X 3; c, banner, X 3; e, legume, X 1. Drawn from Judd 1409.

glabrous with age above. Inflorescences axillary, racemose, with flowers borne in small fascicles along axis and flowerbearing portion 2–6 cm long; bracts narrowly triangular, to 2 mm long, with acuminate apex, bracelets smaller; peduncle 2.5–6 cm long, bearing usually 1 or 2 minute to foliaceous bracts. Pedicels 2–4.5 mm long, moderately to densely pilose, with 2 small narrowly triangular bracteoles at apex. Calyx tubular and bilabiate, 9–14 mm long, moderately pilose and adaxially roughened, red; the 2 upper sepals completely united forming a broad lobe with free portion 3.5–5.5 mm long, with acute to shortly acuminate apex; 2 lateral lobes much smaller, 2.5–3 mm long, and narrowly ovate; narrowly lanceolate lower lobe slightly longer than upper lobe, 4–5.5 mm long, with acute to acuminate apex. Corolla zygomorphic, red; banner oblong, erect, folded, auriculate, to ca 27 mm long (but in bud only ca 12 mm); wings narrowly oblong and asymmetrically auriculate, smaller (ca 5.5 mm in bud), connivent with keel; keel petals connate, $\pm$ oblong and asymmetrically auriculate, smaller (ca 9.5 mm in bud). Stamens diadelphous, with tube slightly adnate to base of wing and keel petals; filaments alternating long and short; anthers ca 1 mm long. Ovary short-stipitate, many-ovuled, densely pilose; style slender, glabrous; stigma minute. Legume linear, flat, very short stalked, 2-valved, densely pilose, probably elastically dehiscent (only immature fruits seen).

TYPE: DOMINICAN REPUBLIC. PROV. LA VEGA: Loma de la Sal, ca 10 km south of Jaraboca, ca 1280 m alt. in disturbed openings in moist cloud forest, 9 May 1976, W. S. Judd 1409 (HOLOTYPE: FLAS).

Rhodopis lowdenii is easily distinguished from *R. planisiliqua* by its more coriaceous leaflets, i.e., more or less inflexible when dry, with the primary, secondary and tertiary veins clearly adaxially impressed and abaxially raised-reticulate. The leaflets are thus distinctly bullate. In addition the calyx, inflorescence axis, lower leaf surface and petiole are more densely pilose. The flowers are smaller, and the peduncles shorter (2.5–6 cm). The red flowers of both species make bird pollination likely (see Kalin-Arroyo, 1981). Both taxa occur in the Cordillera Central of Hispaniola and they may prove to be sympatric, however, *Rhodopis lowdenii* is presently known only from the type locality.

It is a pleasure to name this distinctive species after Dr. Richard M. Lowden, plant taxonomist at the Universidad Catolica Madre y Maestra, Santiago de los Caballeros, Dominican Republic. His hospitality and helpfulness greatly facilitated my field work in the Dominican Republic.

REFERENCES

- BARKER, H. D. and W. S. DARDEAU. 1930. Flore d' Haiti. 456 pp. Service Technique du Department de L'Agriculture et de L'Enseignement Professionel, Port-Au-Prince.
- BRITTON, N. L. and P. WILSON. 1924. Scientific survey of Porto Rico and the Virgin Islands. 5: 426–427.

- KALIN-ARROYO, M. T. 1981. Breeding systems and pollination biology in Leguminosae. Pp. 723–769 *in* R. M. Polhill and P. H. Raven (eds.), Advances in legume systematics. Part 2. Royal Botanic Gardens, Kew.
- LACKEY, J. A. 1981. Phaseoleae. Pp. 301–327 *in* R. M. Polhill and P. H. Raven (eds.), Advances in legume systematics. Part 1. Royal Botanic Gardens, Kew.
- MOSCOSO, R. M. 1943. Catalogus florae Domingensis. 732 pp. Univ. Santo Domingo, New York.
- URBAN, I. 1900. Leguminosae novae vel minus cognitae. I. Symbolae Antillanae 2: 257–335.

OPUNTIA HEACOCKAE (CACTACEAE) A NEW SPECIES FROM CENTRAL COLORADO

GERALD K. ARP

*Principal Research Geobotanist, Arco Oil and Gas Co.,
Dallas, TX 75221*

For years it has been known that a dwarf, dry fruited opuntia grows in the mountains of central Colorado. The plant came to be known under the name of *Opuntia schweriniana* K. Schum. (1899) after Boissevain and Davidson missapplied the name in their book, *Colorado Cacti* (1940). At first glance the cactus appears to be a dwarf, nearly spineless form of *Opuntia polyacantha* Haw. Not until 1970 was the true nature of this taxon evident. At that time, during analysis of populations of this plant, it was found that the dwarf opuntia develops areoles, glochids, spines and pads from its cordlike roots in addition to occasional tubers on some of its finer roots. These features clearly separate the dwarf opuntia from *O. polyacantha* and provide a method of asexual reproduction which allows *Opuntia heacockae* to survive and colonize high altitude habitats that are otherwise not accessible to other opuntiads in Colorado.

OPUNTIA HEACOCKAE Arp, sp. nov. (Figs. 1–6).

Plantae coloniales, habitu pumilo, areolas, glochidia, spinas, articulosque ex radicibus funiformibus efferentes; articulis parvis, 2.5–5.5 cm longis complanatis, obovatus, flavovirentibus, variabiliter spinulosis; floribus rotatis, flavis vel roseis, 4.5–5.5 cm diametro; fructu baccam parvam siccam cyanthiformem usque ad 1.6 cm diametro.

Joints compressed obovate, 1.2–4.5 cm wide, 2.0–5.5 cm long and 5.0–10.0 mm thick. Epidermis yellow-green, tubercled and often shriveled on the older joints. Areoles oval 1.0–3.0 mm long, composed of short gray hairs (when young) with brown glochids to 2.0 mm long and minutely barbed. Spine bearing areoles mostly on the upper portions of the pad. Spines 0–4 per areole, 1.5–2.5 cm long and 1.0 mm in diameter, tan to yellow when young and gray with age; either erect or suppressed; basally flattened in cross section with occasional long spines circular in cross section. Leaves green, acuminate and early deciduous. Colonies to 50 cm in diameter with numerous interconnected colonies scattered especially below the parent. Roots either fibrous or tuberous. Tubers when present, spindle shaped to 5.0 cm long and 1.0 cm in diameter. Fibrous roots of two types, short feeder roots which reside beneath the plant and cordlike roots which radiate away from the plant. Cordlike roots to 2.0 m in length, 1.0 cm in diameter; giving rise to spine and glochid bearing areoles and new joint and joint clusters along

their length; the phenomenon is common and widespread. Flowers rotate 4.5 to 5.5 cm diameter, petals yellow to pink, entire, mucronate, to 7 mm wide and 15 mm long. Stigma lobes 7, green, to 4.0 mm long. Fruit a cup shaped berry, 1.8–2.5 cm long and 1.6 cm diameter nearly or completely spineless, tuberculate and dry at maturity. Seeds white, irregular, 3.5 mm wide, 4.0 mm long and 1.0 mm thick.

TYPE: COLORADO. CHAFFEE CO.: south facing slopes 5.7 mi W of Trout Creek Pass, at 9340 ft elev. in open pinyon-juniper woodlands, 17 Apr 1984, *G. K. Arp* 4841 (HOLOTYPE: SMU; ISOTYPES: CSU, POM).

Additional specimens: *G. K. Arp* 1427, 1430, 1431, 1432, 1433, 1437 (COLO) and 4846, 4847 (SMU).

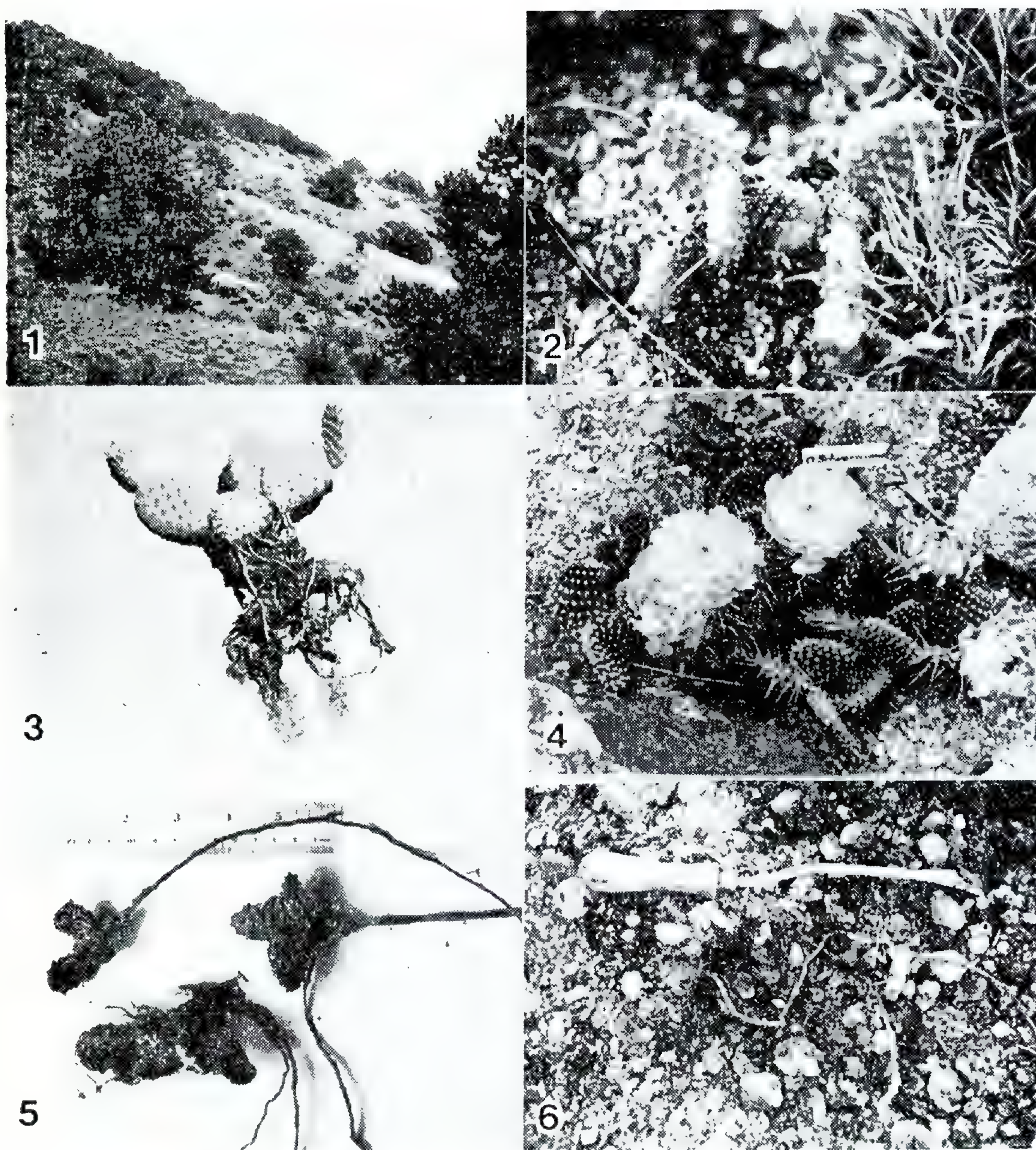
DISTRIBUTION: Head waters of the Arkansas River from the slopes of the Collegiate Peaks to Trout Creek Pass and from Buena Vista to Salida. Also in the head waters of the Gunnison River to the Morrow Point Dam and west to Cortez, Colorado. Possibly also in the northwestern portions of state near Maybell, Moffat Co. Colorado.

DISCUSSION

Opuntia heacockae is named for Mrs. Mary Ann Heacock of Denver, Colorado, a student of North American cacti for over 40 years. *Opuntia heacockae* has long gone under the name of *O. schweriniana* Schum. which is in reality a synonym of *O. fragilis* (Nutt.) Haw. according to Benson (1969, 1982). The plant differs from Schumann's original description in pad shape, most factors of spination, areole characteristics and all aspects of root sprouting. Lengthy garden studies confirm the dwarf habit, the root sprouting characteristics and the stability of other morphological features that distinguish the plant.

While many authorities have referred the plant directly to *Opuntia polyacantha* Haw., *O. heacockae* is actually intermediate between *O. polyacantha* a widespread great plains species and *O. arenaria* Engelm. a sand dune inhabiting species from near the Rio Grande River in southern New Mexico and Western Texas. With *O. polyacantha* it shares similarities of pad shape and some aspects of spination. With *O. arenaria* it shares its dwarf habit, its production of aeroles, glochids, spines and new pads from the cordlike roots. From both species *O. heacockae* differs in its production of occasional tuberous roots and its unusual high altitude distribution.

Confusion over the misapplication of *Opuntia schweriniana* is traceable to the fact that both *O. fragilis* and *O. heacockae* occur at the type location of Schumann's *O. schweriniana*, i.e. old Sapinero, Colorado, along the Gunnison River. Old Sapinero is now covered by the Blue Mesa Reservoir, but it is still possible to find both taxa in the area and they should be expected throughout the Gunnison River valley.



Figs. 1-6. Habitat (1), plant habit (2), plant exhibiting tuberous roots (3), flowering plant in garden of M. A. Heacock (4), three subsidiary clusters with attached cordlike roots (5), habit photo showing parent plant with attached subsidiary clusters, note connecting root (6).

ACKNOWLEDGEMENTS

I would like to thank Wm. F. Mahler and Barney L. Lipscomb for their assistance in the preparation of this manuscript and Paul A. Fryxell for the Latin diagnosis.

REFERENCES

- BENSON, L. 1969. The cacti of Arizona, Univ. of Arizona Press. Tucson, Arizona.
——— 1982. The cacti of the United States and Canada. Stanford University Press.
Stanford, Calif.
BOISSEVAIN, C. H. and C. DAVIDSON 1940. Colorado cacti. Abbey Garden Press.
Pasadena, Calif.
SCHUMANN, K. 1899. Monatsschr. Kakteenk. 9: 148.

SELAGINELLA GYPSOPHILA (SELAGINELLACEAE), YET ANOTHER NEW EDAPHIC ENDEMIC FROM NORTHERN MEXICO

ALAN R. SMITH

Botany Herbarium, University of California, Berkeley, CA 94720

TIMOTHY REEVES

Division of Science and Math, University of Minnesota, Morris, MN 56267

SELAGINELLA GYPSOPHILA Smith & Reeves, sp. nov. (Figs. 1 and 2).

Ex affinitate *S. piliferae* A. Braun et specierum affinium statura parvula, foliis intermediis ellipticis coriaceis bicoloribus margine albidis, sine seta apicali, ramulis (foliis inclusis 1.5–2.0 mm latis distinguenda.

The following description is based upon pressed specimens of dry, inrolled plants.

Plants rosulate, hygroscopic, inrolled when dry; stems densely cespitose, ascending, anisotomously branched with the distal branching dichotomously flabellate, branch systems ("fronds") strongly dorsiventral, not "stipitate" or with a short (to 1.5 cm) unbranched basal portion, green above, yellowish- or whitish-green below, older leaves drying uniformly tan; branches strongly ascending; leaves anisophyllous, both median and lateral leaves 2-ranked, closely imbricate, elliptic, acutish or narrowly rounded at apex, the lateral 1.4–2.0 mm long, 0.7–0.9 mm wide, strongly oblique to axis (ascending at ca 45° angle), ciliolate along upper margin (hairs 0.05–0.10 mm long), mostly entire along lower margin (except at base), bicolorous, lower surface with broad whitish opaque margins up to ca 0.3 mm wide and a green central band that is equal to or less than the width of the whitish margins, on upper surface green central band much broader than whitish margins; median leaves 1.0–1.3 mm long, 0.4–0.5 mm wide, subacute to narrowly rounded at tip, lacking an apical seta, with broad whitish margins 0.15–0.20 mm wide, mostly entire to minutely and remotely denticulate along outer margin, closely denticulate (apical half) to minutely ciliate (basal half) along inner margin, hairs 0.05–0.10 mm long, color pattern reversed from that of lateral leaves, the upper surface with narrow dark green median band, the lower surface with broad green median band; axillary leaves similar to lateral leaves but more nearly equilateral and ciliolate along both margins, base with two minute, ciliolate lobes; strobili at ends of ultimate branchlets, strongly quadrangular, up to 1.5 cm long and 1.0–1.5 (3.0 after sporangia dehisce) mm diameter; sporophylls broadly ovate-deltoid (basal corners clasping sporangia), acute at tip, lacking apical

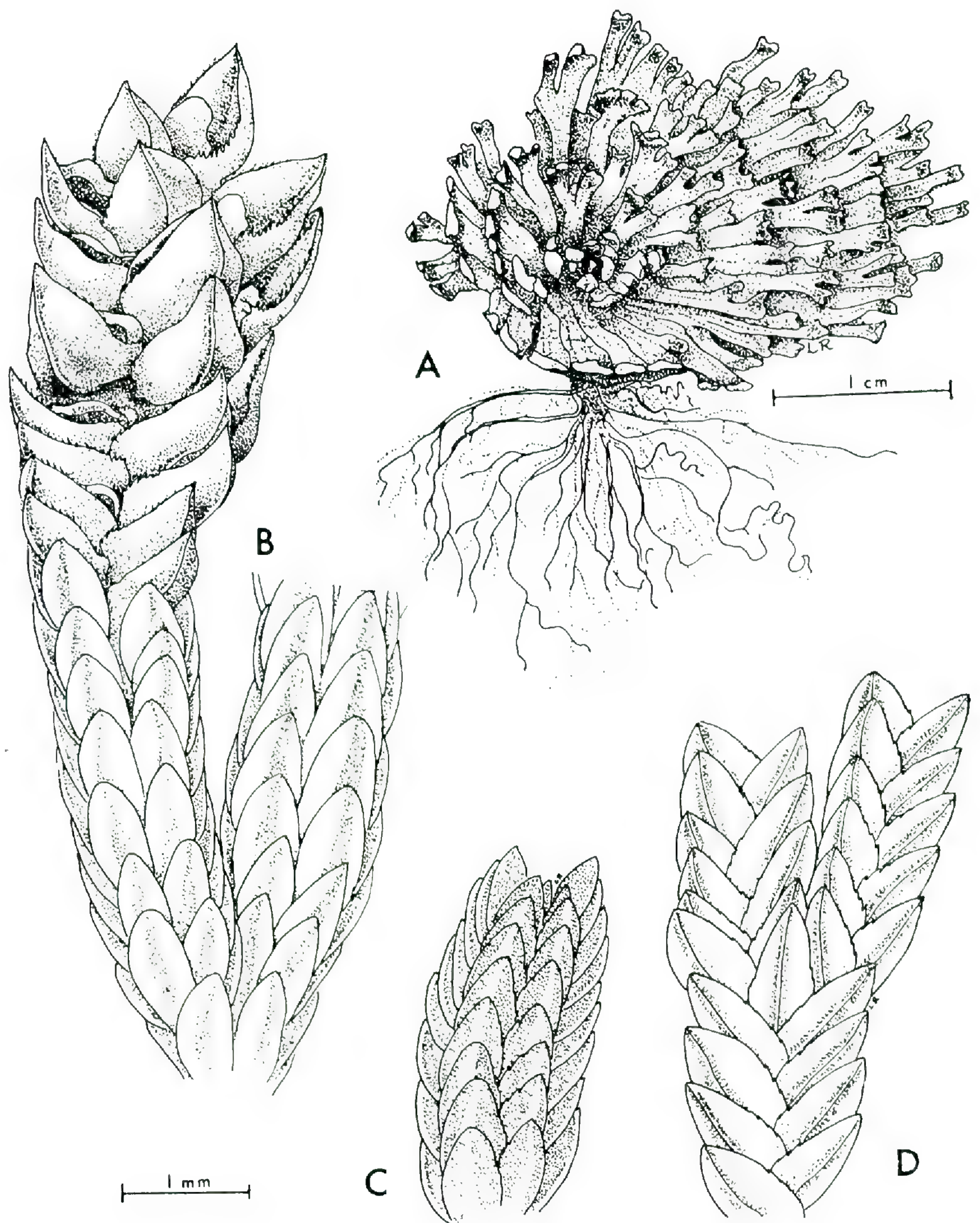


Figure 1. *Selaginella gypsophila* Smith & Reeves (Dorr 2550). A. Habit; wet, expanded plant. B. Branch with strobilus, upper surface; dry, incurled plant. C. Portion of branch, upper surface; wet, expanded plant. D. Portion of branch, lower surface; dry, incurled plant.

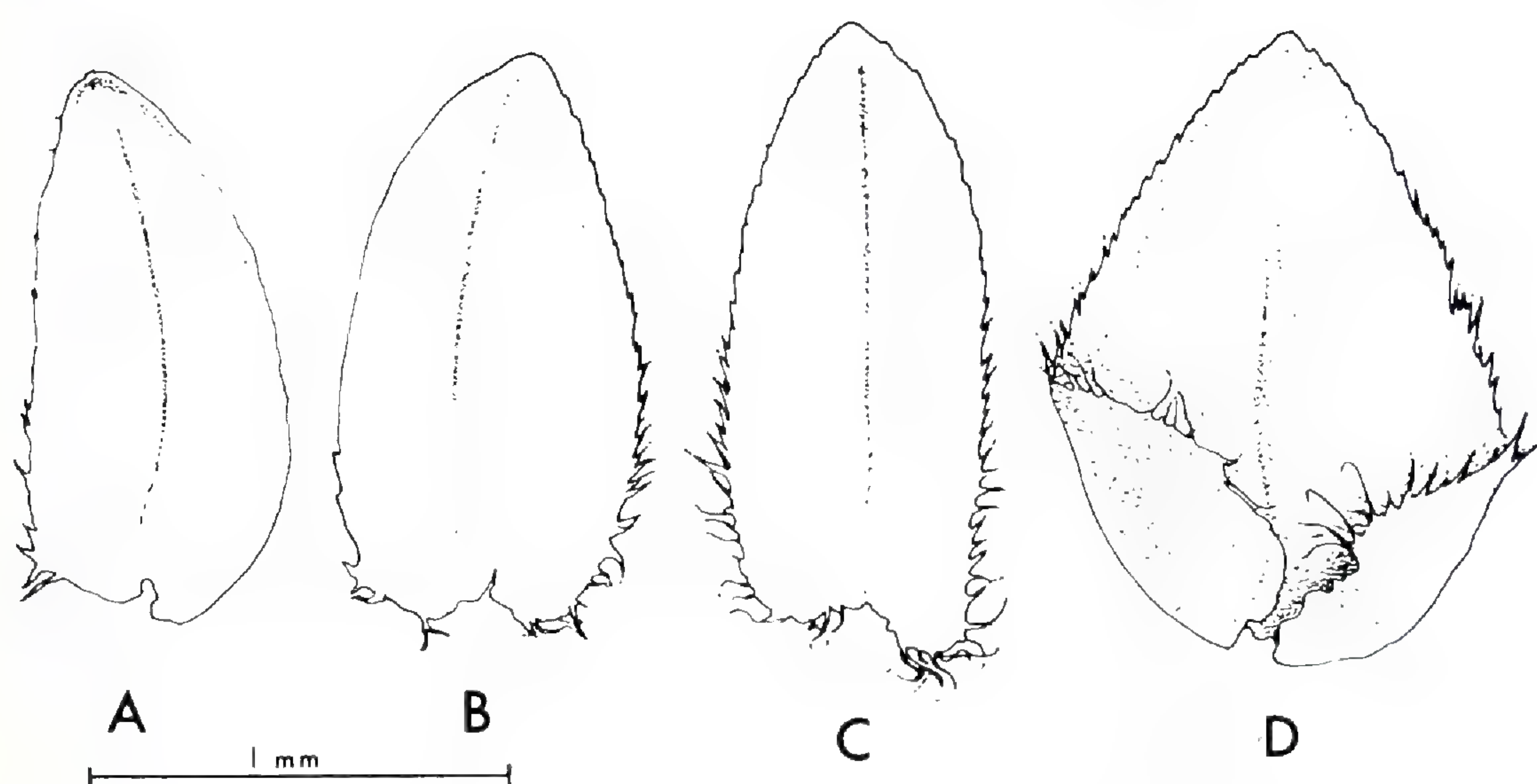


Figure 2. Leaves of *S. gypsophila* (Dorr 2550). Tracings of leaves mounted and cleared in Hoyer's. A. Median leaf. B. Lateral leaf. C. Axillary leaf. D. Megasporophyll showing basal corners that clasp sporangium.

setae, prominently carinate on back, spreading with age, ca 1.2–1.5 mm long, ciliolate on whitish margin, hairs up to 0.1 mm long; megasporangia few, basal, in a vertical file in strobilus, or scattered in one or two vertical files; megaspores yellow, up to four per sporangium, ca 300 μm diameter, with fine reticulate ridges, but at low magnification (30 $\times$) appearing smooth except for the triradiate scar; microsporangia numerous, with microspores bright orangish-red, capitate-papillate or tuberculate, shed in tetrads (and singly).

Plants that have been rehydrated and allowed to expand show some differences from the above description. The lateral leaves spread somewhat more widely from the stem when wet. Also, the median band on the upper surface of the median leaves and the lower surface of the lateral leaves is paler (not darker) than adjacent tissue.

TYPE: MEXICO. NEUVO LEÓN: Munic. Galeana, low gypsum hills S of Cerro Potosí, ca 2 mi N of Ejido Santo Domingo and ca 7 mi NE of San Roberto Junction (Hwys 57 & 58), 24°45'N, 100°12'W, 2100 m, 24 Oct 1982, L. J. Dorr 2553, with J. Grimes, K. C. Nixon, S. Sundberg (HOLOTYPE: UC; ISOTYPES: GH, MEXU, MICH, MO, NY, TEX, US).

PARATYPE: same locality, Dorr 2550 (MEXU, TEX, UC).

Gypseous soils of northern Mexico continue to be the source of many novelties (Turner & Powell, 1979). This remarkable new *Selaginella* was discovered growing both on gypseous soils (2553) and on the surface of a

gypsum mine (2550); the two populations were several hundred meters apart. According to the collector, the area was relatively barren except for the presence of scattered plants of *Notholaena bryopoda* Maxon and *Heterotoma pringlei* B. L. Robinson. The two gatherings of *Selaginella* comprise a total of about 50 plants, the largest of which is about 11 cm across. Other associates in the area included *Hedeoma ciliolatum* (Epling & Stewart) Irving, *Houstonia rubra* Cav., *Brickellia nelsonii* B. L. Robinson, *Helianthella gypsophila* Turner, *Pinus arizonica* Engelm., *Polygala* sp., and *Cheilanthes cochisensis* (Godd.) Mickel, this last species on non-gypsophilous soil.

Selaginella gypsophila is a member of subg. *Stachygynandrum* (Beauv.) Baker, more specifically of the group of *S. lepidophylla* (Hook. & Grev.) Spring, or "resurrection ferns," comprising also *S. pilifera* A. Braun, *S. novoleonensis* Hieron., *S. convoluta* (Arn.) Spring, and *S. pallescens* (Presl) Spring (Alston, 1955). This group is centered in northern Mexico. From *S. lepidophylla*, our new species differs by having elliptical median leaves (vs. nearly round or broadly ovate), lacking a dense fringe of hairs from a scarious margin, lateral leaves aging tan beneath (vs. dark red-brown), megaspores with fine reticulate ridges (vs. strongly reticulate ridges), and microspores darker reddish-orange and capitate-papillate or tuberculate (vs. strongly ridged). The microspore tetrads in *S. lepidophylla* are enclosed in an "extra tetrad wall" which is not present around tetrads in *S. gypsophila*. Also, the leaves of *S. lepidophylla* do not have a contrasting central band, and the basal corners of the sporophylls do not clasp the sporangia. From *S. novoleonensis*, it can be distinguished by the non-aristate median leaves, leaves with central green band darker than adjacent tissue in dry condition (vs. central green band lighter than adjacent tissue when dry or wet), the older leaves drying tan (vs. dark brown), the finely reticulate megaspores (vs. strongly reticulate), the capitate-papillate or tuberculate microspores (vs. strongly ridged), the lack of an "extra tetrad wall" enclosing microspores, and the non-clasping sporophylls. *Selaginella convoluta* differs in having more ovate median leaves, lateral and median leaves more acute (median sometimes aristate) and without contrasting median band, more widely divergent lateral leaves (ca 60°–80° from axis), coarse cilia along all leaf margins, yellow-orange microspores that are roughened with low tubercles, whitish and coarsely tuberculate megaspores, non-clasping sporophylls, and a silvery sheen on under surface of the lateral leaves. From *S. pilifera*, perhaps its closest relative, it differs in lacking apical setae on the median and lateral leaves, lateral leaves much less widely divergent from axis, and lacking the silvery sheen of the under surface of the lateral leaves. The megaspores of *S. pilifera* are whitish. *Selaginella pilifera* has weakly bicolorous leaves, in contrast to the rather sharply bicolorous leaves of *S. gypsophila* (the color pattern is very similar). The median leaves of *S. pilifera* are more elliptic than other species in the group and thus more similar to *S. gypsophila*. Additional similarities between the two are the

clasping sporophylls, spore ornamentation, and having microspores shed in tetrads as well as singly. *Selaginella pallescens* seems less closely related, having setate leaves with conspicuous and clearly defined white margins with longer and more numerous cilia, leaves without contrasting central band, a more frondose branching pattern, often elongate-stipitate fronds, more divergent lateral leaves, whitish megaspore, and microspores shed mostly singly (rarely in tetrads). Megaspore ornamentation, microspore color (ornamentation varies from inconspicuously low-tuberculate to capitate-papillate), and clasping sporophylls in *S. pallescens* are similar to *S. gypsophila*.

A single specimen on the holotype sheet ("A") has the median and lateral leaves awned to 0.5 mm; however, these awns are not as long as those found in *S. pilifera* where they are half to equalling the leaf length. This specimen is excluded from our concept of the species pending further study of additional collections. It may, however, represent only an extreme variation. In other aspects, it appears essentially identical to other specimens of the type gathering.

ACKNOWLEDGMENTS

We thank Linda Reeves, wife of the junior author, for preparing the illustrations. Larry Dorr kindly supplied color slides and notes concerning the type locality.

REFERENCES

- ALSTON, A. H. G. 1955. The heterophyllous Selaginellae of continental North America. Bull. Brit. Mus. (Nat. Hist.), Bot. 1: 221–274.
- TURNER, B. L. & A. M. POWELL. 1979. Deserts, gypsum and endemism. In Goodin, J. R. & D. K. Northington, eds., Arid land plant resources. pp. 96–116. International Center of Arid and Semi-arid Land Studies, Texas Tech University, Lubbock.

SENECIO MILLEFOLIUM T. & G. (ASTERACEAE) AND ITS INTROGRESSANTS

LEONARD J. UTTAL

*Biology Department, Virginia Polytechnic Institute and
State University, Blacksburg, VA 24061*

ABSTRACT

Senecio millefolium T. & G. is restricted to the character of its protologue and a lectotype is designated for it. *Senecio memmingeri* Britt. is removed from the synonymy of *S. millefolium* and designated a hybrid between that species and *Senecio anonymus* Wood.

The author agrees with Barkley (1962) that present knowledge or relationships within the widely introgressing genus *Senecio* L. is insufficient to maintain formal taxonomic sections and the use of convenient species groups, as proposed by Barkley (1978), is presently more utile. *Senecio millefolium* T. & G., a rare endemic of the southern Blue Ridge, is the only eastern representative of the species-group *Lobati sensu* Barkley (1978) and it is unique in this group in that its foliage is infinitely divided into lace-like segments yarrow fashion.

Senecio millefolium is invariably described in publications with this character, in conformity with its protologue. Yet, in herbaria, under this name, are filed a number of specimens which deviate from this character in that the leaf tissue is more or less continuous, with digitate processes at the ends of the lobes. Such a specimen (Fig. 2) was described as *Senecio memmingeri* Britton in 1893 and was recognized as a species until Alexander (1937) called the type on "aberrant" *S. millefolium*. Thenceforth such plants have been treated as a "broad-leaved" phase of *S. millefolium*. This phase was suggested by Barkley (1968) to represent a hybrid between *Senecio anonymus* Wood and *S. millefolium* but he did not pursue this hypothesis. Radford *et al.* (1968) suggested this phase might be a variety of *S. anonymus*.

This author visited a number of stations of *S. millefolium* in the spring of 1983 and found that *S. anonymus* is usually present in the vicinity of the other species. A study of 69 specimens labelled *S. millefolium* in 13 herbaria, certainly most of the specimens extant, revealed that 14, or about 20%, of these specimens are more or less broad-leaved and introgressant between the narrowly segmented bi- or tripinnate-leaved plants of *S. millefolium* and *S. anonymus*. The situation is further complicated by the fact that there is a phase of *S. anonymus* from rocky habitats in the southeastern United States, including the range of *S. millefolium*, with the leaves more dissect than those of plants from general habitats, and in which the normally

entire basal leaves wither early and are commonly missed by collectors (Fig. 3). Such plants are occasionally taken to be *S. millefolium* (Uttal, 1971). The result of these observations is that it is deemed necessary to redefine *S. millefolium* and its introgressants. In the original description, the three types are syntypes, making it necessary to select a lectotype.

SENECIO MILLEFOLIUM Torrey & Gray, Fl. N. Amer. 2: 444. 1843. LECTOTYPE, here designated.: "Table Rock, S. Car." Buckley s.n. GH! ISOLECTOTYPE: NY! ISOLECTOTYPE reported in MO by Greenman (1915); not located. LECTOPARATYPES, here designated: "Whiteside Mt., N.C. 1839" M. A. Curtis s.n. NCSC!; "Carolina, Fraser" PH! (Minute fragments derived from this specimen were taken by Gray and placed in an envelope mounted on the lectotype sheet in GH and designated (1) holotype by Barkley (1968) and (2) "part of type" by Greenman (l.c.). The locus of the main specimen was traced to PH by reference to Miller (1970).

Herbaceous perennial 2.5–5 (–7) dm tall, glabrous except for occasional persistent ecru floccose axillary tomentum, sometimes lightly pubescent around the base of the receptacle. Stems strict, usually single or occasionally 2 or 3 from a short fibrous-rooted closely branched rhizome-caudex. Basal leaves and persistent leaf-tufts evergreen, fleshy, ovate to narrowly ovate in gross outline (6–) 10–15 (–30) cm long, including the often roseate petiole, (2–) 3–5 (–8) cm wide, 2 or 3 times pinnately dissected, the segments ultimately linear to filiform, 1–2 (3) mm wide. Cauline leaves 2 or 3 (–5), about half the size of the basal leaves or less, deciduous. Inflorescence an open subcorymbiform cyme with (5–) 8–20 (–60) heads. Involucre bracts about 21 (13) in number, 4–5 (–6) mm long, acute, green, pink to brown-tipped, apex minutely floccose. Calyculate bracts acerose, 1–2 mm long, 2–3 in number. Disk 5–8 mm wide, rays 8–10 (–13), ligules 8–12 mm long. Achenes pubescent along the angles. Late April–July. (Fig. 1).

DISTRIBUTION: Local, associated with granite (the rootlets of dried specimens often bear quartz crystals), in the Blue Ridge from Mitchell County, North Carolina to Rabun County, Georgia and adjacent South Carolina. Also on foothills and monardnocks in South Carolina. Not in Virginia (Uttal, 1971).

Because the species is threatened (22 stations were tallied from an assemblage of most extant specimens) it is decided to forego the customary practice of listing representative specimens. Most specimens I saw were collected long ago, some from presently unproductive stations, others from environmentally threatened stations. Recent collections have been relatively few. Many collections are repeats from same stations. Possibly remote sites may harbor undiscovered populations but these are predictably few. Representative specimens may be consulted in the herbaria from which I borrowed. Figure 1 serves graphically.

As noted above, *S. anonymus* is a frequent associate of *S. millefolium* and the two sometimes introgress after the manner of aureoid ragworts as re-



Figure 1. *Senecio millefolium* (Uttal 12992, VPI). Photograph by R. Vilgalys.



Figure 2. *Senecio memmingeri*, holotype (*Memminger s.n.*, NY), *S.* $\times$ *memmingeri* (pro sp.) (*S. anonymus* $\times$ *millefolium*). Phtograph by R. Vilgalys.

ported by Barkley (1962) and Uttal (1982). Such introgressants are disposed of as follows:

SENECIO $\times$ MEMMINGERI Britton (pro sp.) (*Senecio anonymus* $\times$ *millefolium*).

Senecio memmingeri Britton in Small, Bull. Torrey Bot. Club 25: 147. 1898.

HOLOTYPE: "Henderson County, N.C., 1887", E. R. Memminger s.n. (NY!);

PARATYPE: "Alabama, Lee Co., 16 May 1896", F. S. Earle and L. M. Underwood

(NY!); PARATYPE: "Blowing Rock Mt., N.C., 4300 feet", 10–20 Jun 1891,

J. K. Small s.n. (NY!). Each paratype is discordant with the holotype. Each is *Senecio anonymus* Wood.

Senecio millefolium var. *memmingeri* Britt. in Small & Heller, Mem. Torrey Bot. Club 3(1): 28. 1892, a nomen nudum.

With the gross aspect of *Senecio millefolium*, but the leaf lobes more or less expanded, membranaceous, including basal leaves and leaf tufts, with digitate processes at the end of the pinnae. Upper cauline leaves similar to those of *S. millefolium*. Stems often multiple from the essentially horizontal rhizome-caudex, often arcuate and ecru-tomentose at the base. Heads generally smaller and more numerous than as in *S. millefolium*, or sometimes as large, in open corymbiform cymes. Introgression is complete and it is difficult to identify nothomorphs approaching parental phenotypes. Figure 2.

DISTRIBUTION: Narrowly within the range of *S. millefolium* but more catholic in habitat tolerances, not confined to granite derived soils, and accepting ruderal habitats occupied by *S. anonymus*.

The hybrid, while not swamping out the rarer parent, makes the total number of genetically pure *S. millefolium* less than previously thought, and thus more threatened.

Again, for conservation purposes, it is thought expedient not to list representative specimens. These may be consulted in the herbaria I used. Figure 2 is representative enough.

Common names for *Senecio millefolium* are numerous for such a rare species. They include Piedmont Ragwort (a misnomer), Divided-leaf Ragwort, Thousand-leaf Ragwort, and Yarrow-leaved Ragwort. I propose for a common name Blue Ridge Ragwort to express its endemism and to avoid futile, inaccurate, pictorially descriptive names.

ACKNOWLEDGMENTS

Specimens from the herbaria BM, CLEMS, DUKE, FUGR, GA, GH, MO, NCSC, NCU, NY, PH, US, and VPI were annotated and I think the curators for their courtesies. I especially thank the curators of GH, NCSC, NY, and PH for lending type materials. People who furnished me locality data are treated confidentially. Their contributions were essential to this study and they know they have my appreciation. David E. Boufford called my attention to the syntype situation in *Senecio millefolium* and graciously ceded to me the privilege of selecting the lectotype.



Figure 3. *Senecio anonymus* (Uttal 12990, VPI). Specimen from rocky habitat with early withered entire basal leaves. Photograph by R. Vilgalys.

REFERENCES

- ALEXANDER, E. J. 1937. *Senecio millefolium*. Addisonia 20: 31, pl. 656.
- BARKLEY, T. M. 1962. A revision of *Senecio aureus* and allied species. Trans. Kansas Acad. Sci. 65: 318–408.
- . 1968. Taxonomy of *Senecio multilobatus* and its allies. Brittonia 20: 267–284.
- . 1978. *Senecio*. N. Amer. Fl. Ser. II, pt. 10: 50–139.
- GREENMAN, J. M. 1915. Monograph of the North and Central American species of the genus *Senecio*. Part II. Ann. Missouri Bot. Gard. 2: 573–626.
- MILLER, H. S. 1970. The herbarium of Aylmer Bourke Lambert. Notes on its acquisition, dispersal, and present whereabouts. Taxon 19: 489–656.
- RADFORD, A. E., H. E. AHLES, and C. R. BELL. 1968. Manual of the vascular flora of the Carolinas. University of North Carolina Press, Chapel Hill. 1193 pp.
- UTTAL, L. J. 1971. Five amendments to the flora of southwest Virginia. Castanea 36: 79–81.
- . 1982. Promiscuity of *Senecio plattensis* Nutt. in a Virginia county. Castanea 47: 344–346.

SOLIDAGO (ASTERACEAE) IN OKLAHOMA AND TEXAS

CONSTANCE E. S. TAYLOR AND R. JOHN TAYLOR

Department of Biology
Southeastern Oklahoma State University, Durant, OK 74701

ABSTRACT

There are 25 species of *Solidago* (Goldenrod) in Oklahoma and Texas, with 10 species having two varieties each and one species having four varieties for a total of 38 taxa in this treatment. Information includes keys, data on type specimens, distribution maps, drawings of typical leaves, synonymy, discussion of differentiating characteristics, habitat, and one new combination: *Solidago velutina* var. *nevadensis* (Gray) C. & J. Taylor.

INTRODUCTION

Solidago is a North American genus (one Eurasian and two South American species) containing about 75-85 species (Kartesz and Kartesz, 1980; Soil Conservation Service, 1981). Its morphological variation has contributed to a proliferation of names that is matched by only a few other genera. Index Kewensis (1895) lists 361 species of *Solidago* up to 1885. Some of these taxa have since been transferred to other genera, but most lie within the current concept of the genus.

This treatment of *Solidago* excludes *Euthamia* which most taxonomists now consider to be a separate genus (Anderson & Creech, 1975; Sieren, 1970; Taylor & Taylor, 1983). It includes the section *Oligoneuron* and *S. ptarmicoides* (Anderson & Creech, 1975, Brouillit & Semple, 1981; Kapoor & Beaudry, 1966). While *S. ptarmicoides* fits better in *Aster*, it has been reported to form hybrids with *Solidago* taxa.

DISCUSSION

Oklahoma and Texas lie at the southern end of the Great Plains and have great plant diversity. The vegetation includes the swamps and wetlands interspersed within the eastern deciduous forest of the Gulf Coastal Plain. The Ouachita Mountains of Oklahoma are allied to the plateaus of Kentucky and Tennessee, and provide outposts for many species at their southwestern limits of range. The grasslands are varied; Oklahoma's are mostly allied with the grasslands of the northern Great Plains; and Texas has its blacklands, coastal prairies and various semiarid grasslands. Farther west, both Oklahoma and more substantially Texas have elevations sufficient to maintain some elements of the Rocky Mountain biota. Most *Solidago* species are therefore limited in range within the states. If a species is found

throughout the area, it is represented by several varieties. The two most commonly collected species, based on specimens in herbaria, are *Solidago canadensis* (including *S. altissima*) and *S. gigantea*. *Solidago auriculata*, *S. sempervirens*, *S. stricta*, *S. tortifolia*, and *S. wrightii* are found only in Texas, while *S. hispida* and *S. ptarmicoides* occur only in Oklahoma.

The extreme variation in climate produces morphological variation in response to extremes of rainfall, temperature, and other stress limits for survival. This phenotypic plasticity of perennial plants often results in a species being named several times. As Oklahoma is between the southern coastal and central Missouri and Kansas centers of botanical activity, many species are passing under different names in adjacent state floras or atlases.

Other environmental factors affect appearance as 1) leaf drop during a dry season, 2) insect eggs laid in the apical meristem causing atypical lateral branching that produces unusual inflorescence shapes and smaller leaves, 3) mowing of roadsides and cattle grazing produce the same results, 4) there are also indications that interaction of photoperiod, time of flower initiation, and inflorescence branching often causes the southern varieties to have a larger more diverse inflorescence. The lower branches are much longer, and the heads usually occur only toward the tip with the lower branch being leafy.

Species with long rhizomes can grow into large clones covering an acre or more; occasionally such clones form a small clump if unfavorable growing conditions exist. A large population presents a uniformity in one field which contrasts with the next clone in an adjacent field and thus, appears very different. Many of these populations have been named as distinct entities (*S. canadensis* for example). Those taxa with a bunch or cluster of stems in which large populations are composed of numerous genetically different individuals have a baseline of greater morphological variation resulting in a broader species concept which generally limits the number of times the taxon has been named (*S. nemoralis* for example).

Many nomenclatural problems have resulted from the phenotypic plasticity of glodenrods, but environment and proliferation of names do not totally account for the complexity of the genus. The base chromosome number of *Solidago* is $n = 9$, but some species have counts of $n = 18$ and $n = 27$. In some instances, chromosome levels can be correlated with distinct morphological features, but in others, diploid and tetraploid individuals can not be distinguished (Beaudry, 1960, 1963, 1968, 1969; Beaudry et al., 1958, 1959; Kapoor & Beaudry, 1966). Chromosome counts are given for species and when a count is from a plant growing in the study area, the location is given. It should be noted that a number of chromosome reports have been based on misidentified plants.

ARRANGEMENT

There are 25 species of *Solidago* in Oklahoma and Texas with 10 having

two varieties each and one having four varieties for a total 38 taxa. Species are numbered and arranged in alphabetical order after the key. Types are noted or designated where feasible. County dot maps are alphabetical except for *S. mollis*, which precedes *S. missouriensis* for clarity of presentation (Figs. 1, 2, 3). For identification and comparison, typical leaves are presented with similar species being placed together (Fig. 4, 5, 6, & 7). Since Correll & Johnston (1970) and other authors have extensive species descriptions, the discussion following each species is designed to emphasize those characteristics most helpful in identification.

KEY TO SOLIDAGO IN OKLAHOMA AND TEXAS

1. Inflorescence corymbose, flat-topped or nearly so.
 2. Involucral bract with several nerves.
 3. Leaves ovate, usually densely pubescent *S. rigida*
 3. Leaves linear to linear-lanceolate, glabrous *S. nitida*
 2. Involucral bract with midnerve only.
 4. Ray flowers white; in south central Oklahoma *S. ptarmicoides*
 4. Ray flowers yellow; in southwestern Texas *S. wrightii*
1. Inflorescence racemose to paniculate, cylindric or widely pyramidal.
 5. Inflorescence racemose, less than 3 cm wide.
 6. Heads axillary, or leafy bracted in lower portion with lanceolate leaves much longer than any axillary racemes *S. caesia*
 6. Heads racemose to narrowly paniculate, leaves in inflorescence small, reduced.
 7. Primary stems glabrous, leaves usually glabrous, the upper appressed, basal leaves 10–30 cm long.
 8. Basal leaves ovate to broadly lanceolate, stem leaves ovate, toothed, the upper leaves small, appressed atypical forms of *S. salicina*
 8. Basal leaves linear, stem leaves linear to narrowly lanceolate, entire.
 9. Leaves just below inflorescence about 2 mm wide, appressed *S. stricta*
 9. Leaves just below inflorescence wider than 2 mm, not appressed *S. sempervirens*
 7. Primary stems pubescent, leaves usually pubescent, basal leaves absent or less than 12 cm long.
 10. Plants densely pubescent with long spreading hairs; stems usually 1 or 2 *S. hispida*
 10. Plants with short appressed hairs; stem several per clump.
 11. Leaves linear depauperate forms of *S. altiplanities*
 11. Leaves ovate to broadly lanceolate.
 12. Basal leaves spatulate to ovate or elliptic, blunt with 1–5 shallow teeth; stem leaves rapidly reduced up stem; heads less than 6 mm tall. *S. velutina*
 12. Basal leaves absent; stem leaves uniform, acute; heads 6 mm or longer.
 13. Plants of Trans-Pecos *S. wrightii*
 13. Plants of central and eastern area *S. petiolaris*

- 5. Inflorescence paniculate, broadest at base, much wider than 4 cm.
 - 14. Primary stem glabrous, rarely with sparse hairs; leaves usually glabrous.
 - 15. Inflorescence essentially glabrous.
 - 16. Leaves broadly ovate, toothed; plants of wooded habitats.
 - 17. Basal rosette of long petiolate ovate leaves, reduced up stems to ovate sessile leaves; heads 6 mm long, pedicellate; achenes striate, pubescent *S. arguta*
 - 17. Basal leaves absent, lower stem leaves deciduous at anthesis; heads 5 mm or less, achenes not striate *S. ulmifolia*
 - 16. Leaves oblanceolate, toothed toward tip, frequently with fastigate leaves; plants of grasslands *S. missouriensis*
 - 15. Inflorescence densely pubescent.
 - 18. Inflorescence racemose to narrowly paniculate, ends of branches erect; heads not secund.
 - 19. Plants eglandular-pubescent; grasslands east of Trans-Pecos *S. speciosa*
 - 19. Plants frequently glandular pubescent; Trans-Pecos *S. wrightii*
 - 18. Inflorescence broadly paniculate, triangular in outline, ends of branches recurved; heads secund.
 - 20. Basal rosette absent; lower leaves absent at anthesis; stem leaves uniform in size.
 - 21. Leaves lanceolate *S. gigantea*
 - 21. Leaves ovate *S. ulmifolia*
 - 20. Basal rosette present; lower leaves 10–30 cm long; leaves reduced upward.
 - 22. Basal leaves linear-lanceolate; pedicels over 10 mm long *S. sempervirens*
 - 22. Basal leaves ovate, toothed; pedicels less than 5 mm long *S. salicina*
- 14. Primary stem pubescent; leaves usually pubescent.
 - 23. Leaves linear.
 - 24. Inflorescence conical, branches erect; leaves up to 9 cm long *S. altiplanities*
 - 24. Inflorescence pyramidal, branches recurved apically; leaves 5 cm or less long.
 - 25. Stem with narrow lines of pubescence to pubescent except for band below leaf node; leaves glandular-dotted *S. odora*
 - 25. Stem densely pubescent; glandular dots obscure or absent *S. tortifolia*
 - 23. Leaves lanceolate, ovate, or elliptic.
 - 26. Stem leaves auriculate, clasping stem *S. auriculata*
 - 26. Stem leaves sessile or petiolate, not auriculate.
 - 27. Inflorescence branches erect, not recurved apically; panicle narrow.
 - 28. Leaves ovate to elliptic, densely pubescent; stems 1 or 2 per plant; eastern woods *S. hispida*
 - 28. Leaves lanceolate to broadly lanceolate, glabrate; stems more than 2 per plant; prairies *S. speciosa*

- 27. Inflorescence branches recurved, heads secund; panicle triangular in outline.
- 29. Leaves serrate.
 - 30. Leaves ovate; leaf venation prominently reticulate beneath with long hairs *S. rugosa*
 - 30. Leaves lanceolate; reticulation inconspicuous beneath, with three nerves *S. canadensis*
- 29. Leaves mostly entire or occasionally with apical teeth on larger leaves.
 - 31. Leaves lanceolate or linear to spatulate, usually more than 5 times longer than broad.
 - 32. Leaves 1-nerved, spatulate.
 - 33. Leaves rather uniform up stem, inflorescence pyramidal, endemic to north central Texas and south central Oklahoma *S. mollis*
 - 33. Leaves reduced up stem, inflorescence mostly longer than broad, widespread *S. nemoralis*
 - 32. Leaves 3-nerved, lanceolate.
 - 34. Inflorescence pyramidal; stem leaves uniform; heads 5 mm tall, or less *S. canadensis*
 - 34. Inflorescence longer than broad; stem leaves reduce upward; heads 6 mm tall *S. velutina*
 - 31. Leaves broadly lanceolate to elliptic, 2–4 times longer than broad.
 - 35. Plants of Rocky Mountain foothills; heads 6 mm tall; inflorescence branches usually recurved and secund *S. velutina*
 - 35. Plants of plains, escarpments, or rocky hills; eastern and central.
 - 36. Inflorescence always compact and dense; leaves broadly ovate, rarely toothed, usually less than 3 cm long *S. mollis*
 - 36. Inflorescence dense to open; longer lower branches with leaves ovate, less than 1 cm long *S. radula*

1. *SOLIDAGO ALTIPLANITIES* C. & J. Taylor. Sida 10:178. 1983. *High Plains Goldenrod*. Figs. 1, 4.

TYPE: OKLAHOMA. Jefferson Co.: 5.6 mi SW of Waurika, 9 Oct 1981, J. & C. Taylor 31007 (HOLOTYPE: DUR; ISOTYPES: GH, MO, NLU, NY, OCLA, SMU, US, WTS).

Plants clumped to spreading in small clones, uniformly covered with short curved hairs; leaves linear and sometimes twisted. It could be confused with *S. canadensis* because of its pubescence, but it does not grow in the same habitat. This taxon is mostly confined to canyons, escarpments and gypsum outcrops of the Red River valley in the high plains area of Oklahoma and Texas.

2. *SOLIDAGO ARGUTA* Ait. var. *BOOTTII* (Hook.) Palmer & Steyerl. Ann.

Missouri Bot. Gard. 22: 659. 1935. *Boott's Cutleaf Goldenrod*. Figs. 1, 5.

S. boottii Hook. Companion Bot. Mag. 1:97. 1835. TYPE: LOUISIANA. [New Orleans, Lake Pontchartraine?], [Summer 1832], *Drummond* 465 (Hooker's assigned number; K?).

This species is usually confused with *S. ulmifolia* because of the similarity of the upper primary stem leaves (both ovate and toothed). *Solidago arguta*, however, has basal rosettes, frequently separated by rhizomes from the base of the flowering stalk, and the lower stem leaves are long-petiolate and usually persistent at flowering. *Solidago ulmifolia*, on the other hand, never has a basal rosette, and the lower stem leaves are early deciduous. It also has smaller flower heads which are more crowded. Both species have forms with the lower inflorescence branches up to 30 cm or longer with flowers only toward the ends. This species is rare or rarely collected in east Texas, but it is common in the Ozark and Ouachita Mountain areas of Oklahoma where it grows in shaded areas in the oak-hickory forest. Taylor & Taylor (1978) has further discussion and history of Oklahoma occurrence.

3. *SOLIDAGO AURICULATA* Shuttlew. ex S. F. Blake. J. Wash. Acad. Sci. 21:326. 1931. *Clasping Leaf Goldenrod*. Figs 1, 7.

TYPE: LOUISIANA, *Leavenworth* (LECTOTYPE: NY; microfiche DUR!); Florida, *Chapman*; Missouri, *Duerinck*.

S. amplexicaulis Martens, Bull. Acad. Brux. 8:67. 1841. = *S. riddellii*.

S. amplexicaulis Gray, Syn. Fl. N. Amer. 1(2):153. 1884.

According to Gray (1884), Shuttleworth distributed collections of Leavenworth, Chapman, and Rugel (from Louisiana to Florida) as *S. auriculata*. Gray also notes that *S. amplexicaulis* Martens is a synonym of *S. riddellii* Frank.

The auriculate, clasping leaves are very distinctive, and this species can be readily separated. It is an infrequent plant of the eastern United States, just barely reaching extreme eastern Texas.

4. *SOLIDAGO CAESIA* L.

KEY TO VARIETIES

- 1. Stems round; leaves not decurrent var. *caesia*
- 1. Stems striated; leaves decurrent var. *curtisii*

4a. *S. CAESIA* L. var. *CAESIA*. Sp. Pl. 2:879. 1753. *Blue-stem Goldenrod*. Figs. 1, 7.

TYPE: "Habitat in America septentrionali, based on Dill. Hort. Eltham. 414 t. 307, f. 395;" sheet 14 labeled *S. flexicaulis* (LINN; microfiche US!).

The axillary clusters of flowers in the leaf axils are distinctive with the leaves narrowly lanceolate to broadly ovate. Despite the common name, our plants have stems either magenta or green. This is the most common variety in moist oak-hickory forests of Oklahoma and Texas. $2n=18$ (Beaudry, 1963; Solbrig et al., 1964).

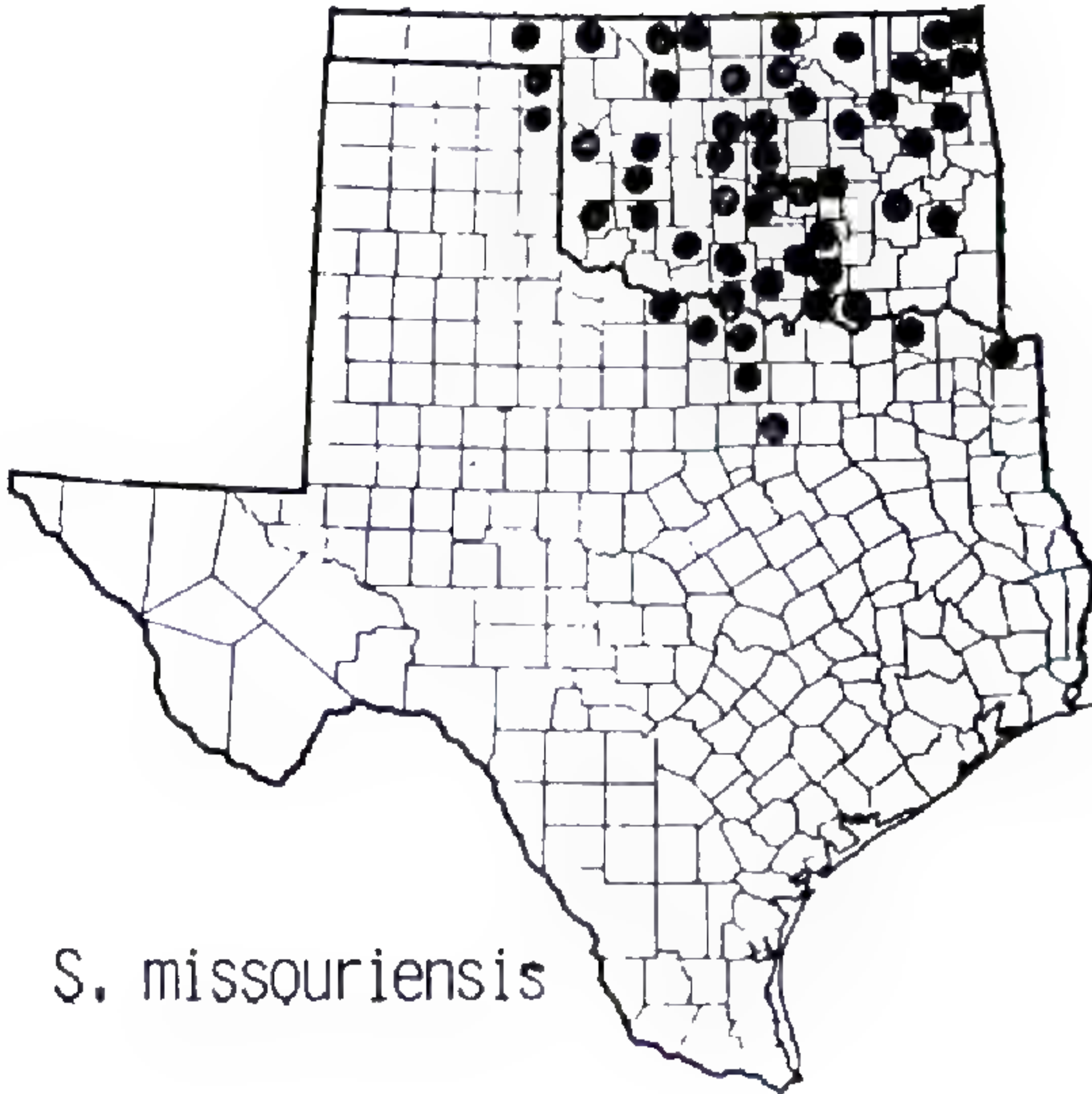
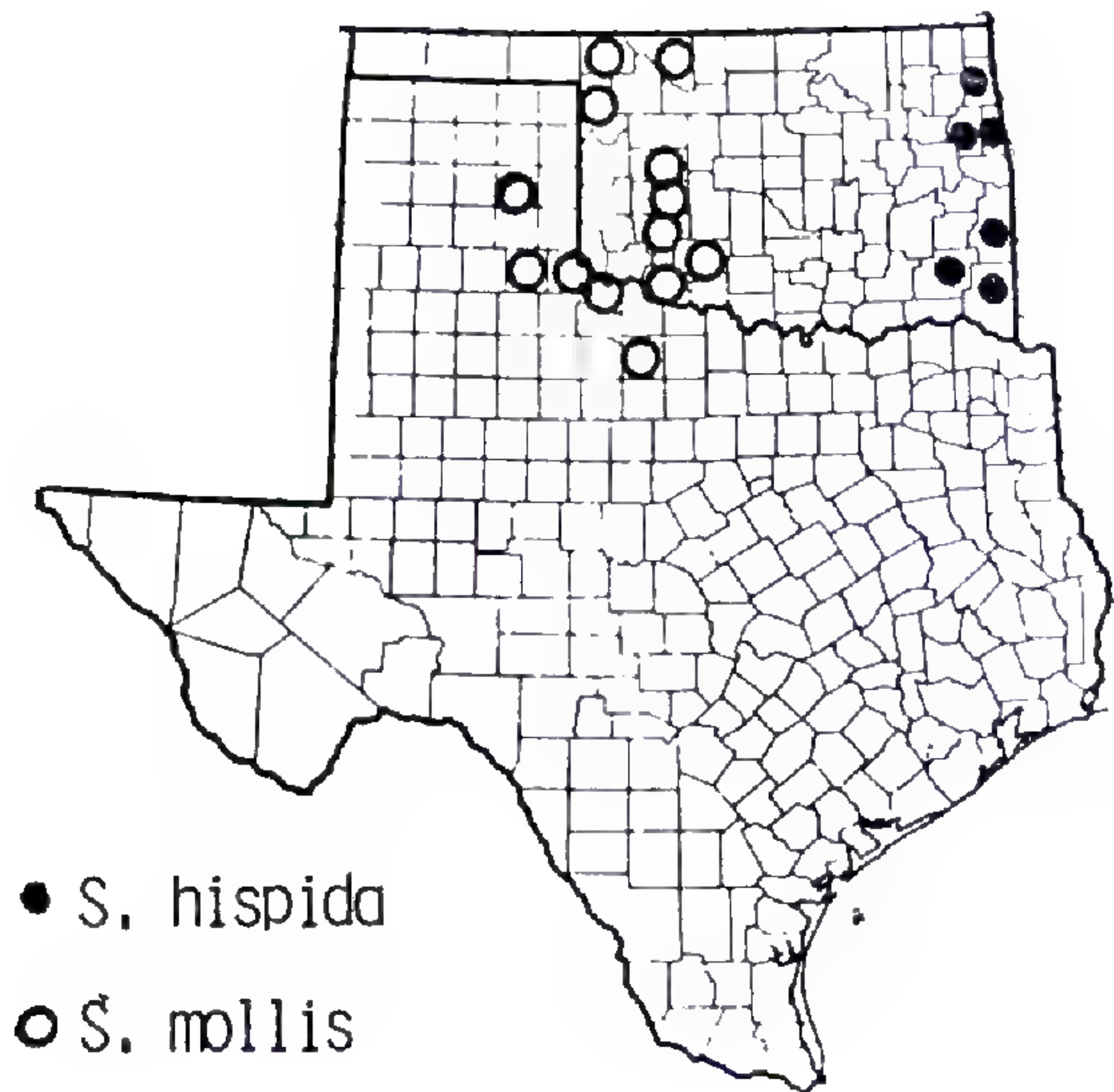
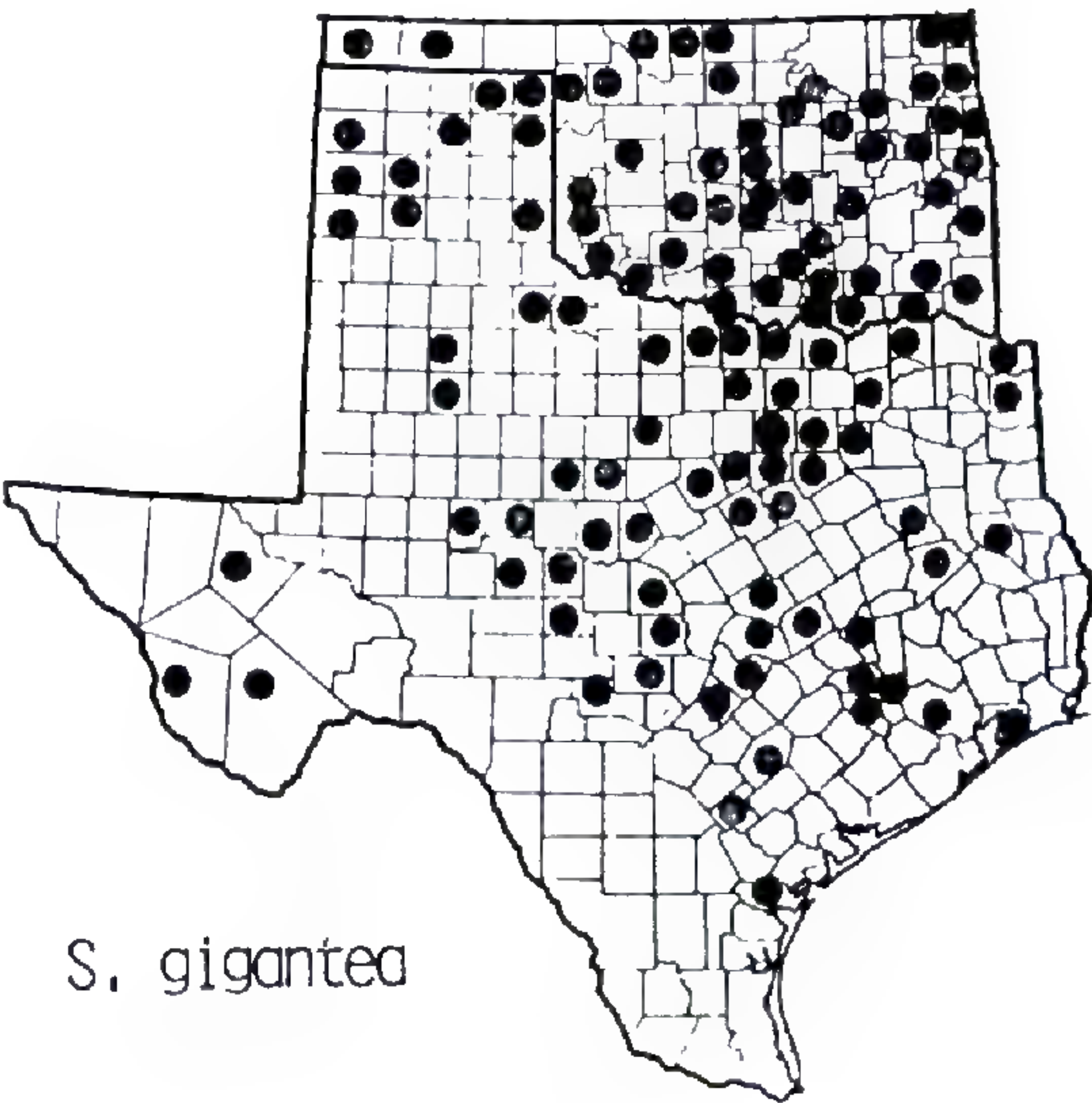
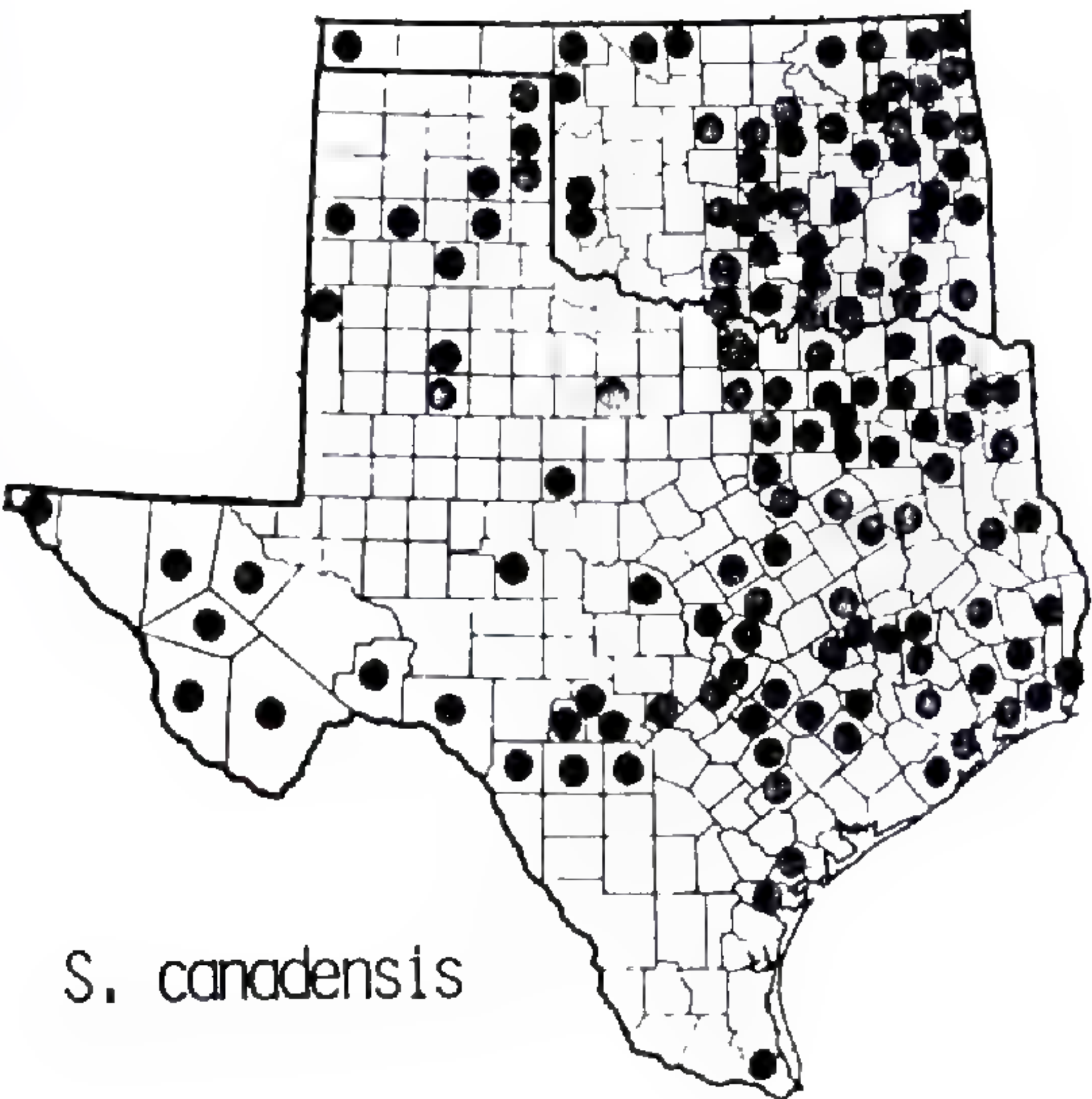
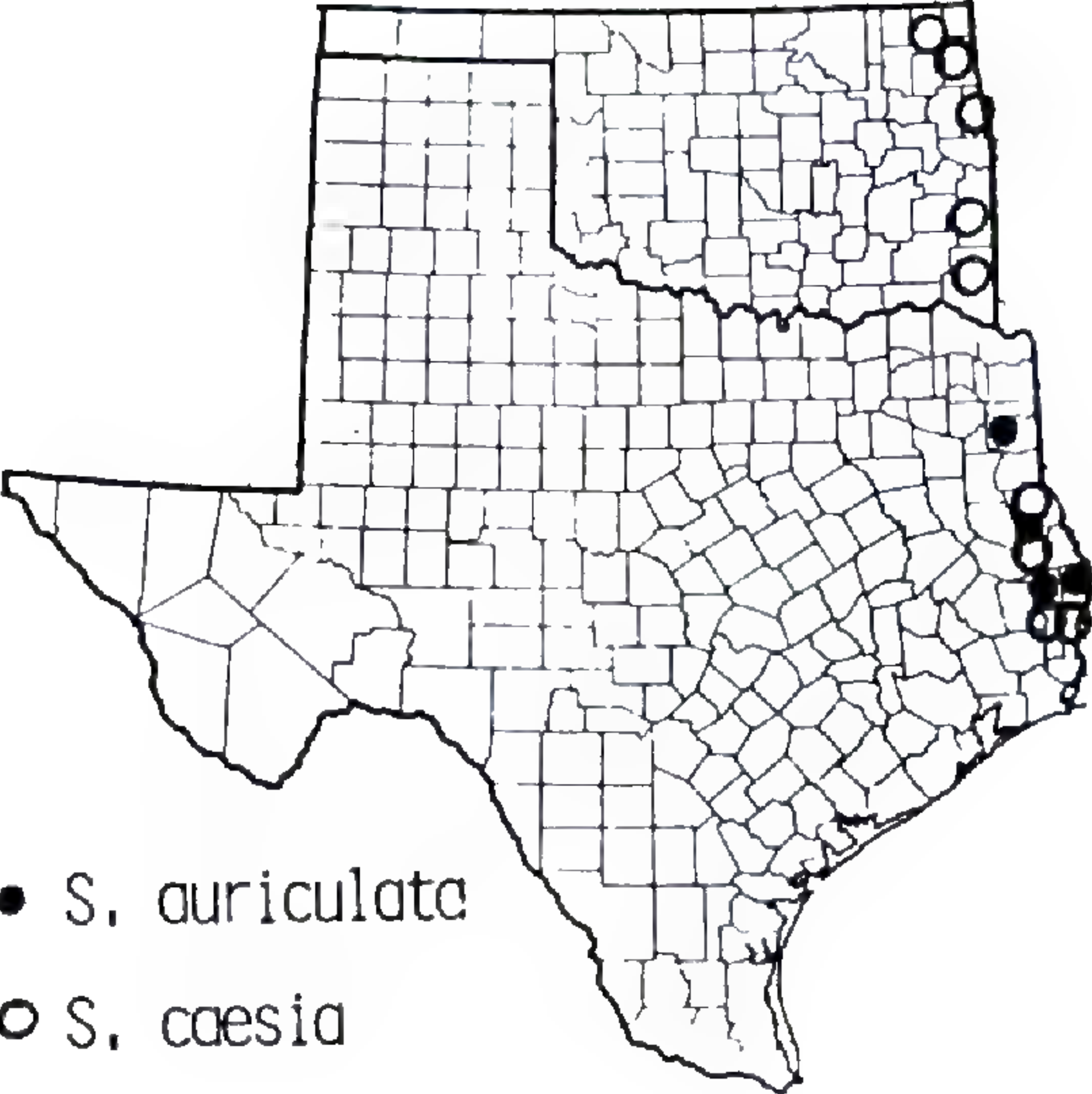
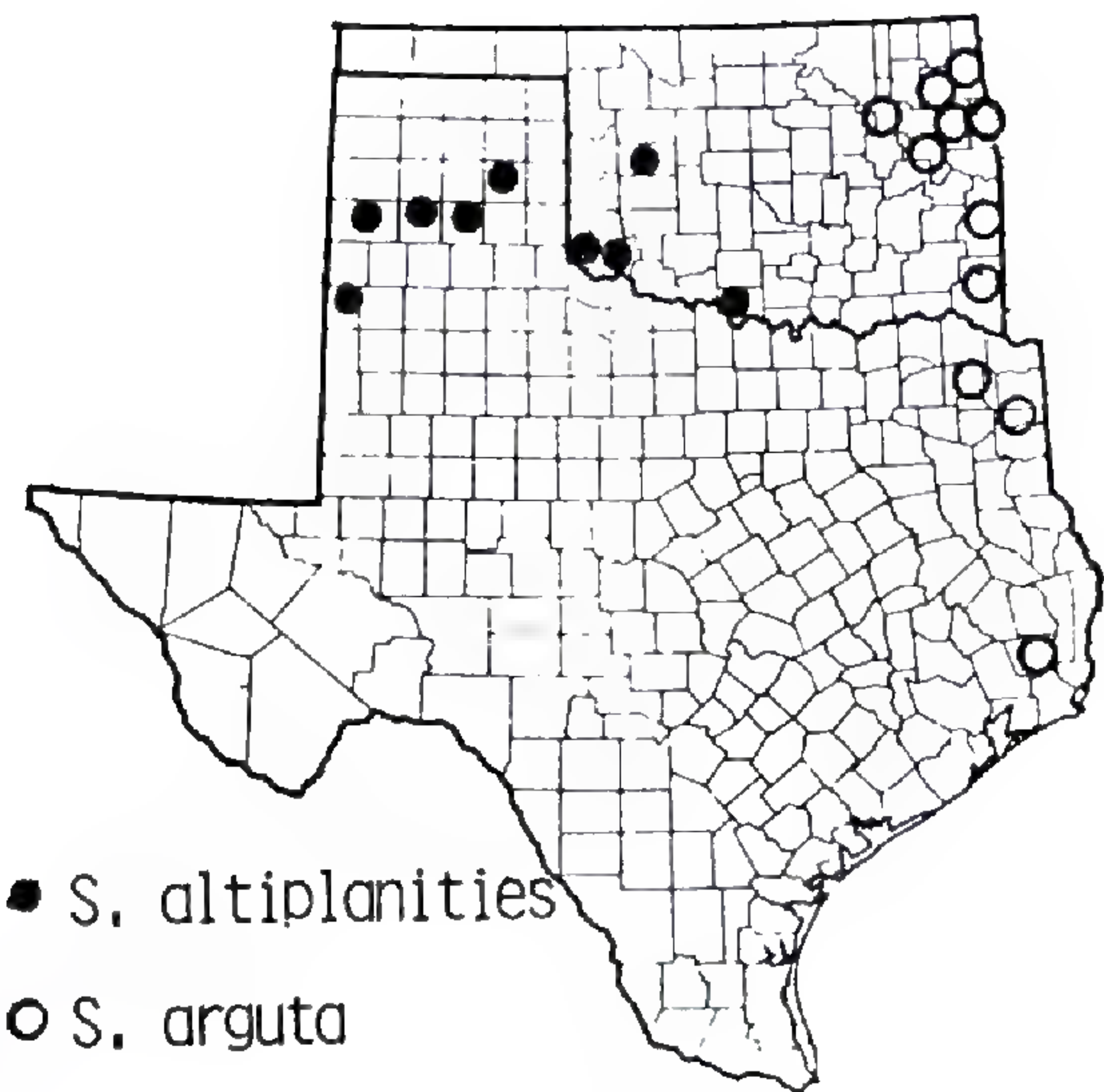


Figure 1.

4b. var. CURTISII (T. & G.) Wood, Classbook. 432. 1861.

S. curtisii T. & G. Fl. N. Amer. 2:200. 1842. TYPE: NORTH CAROLINA. Black Mountains, alt. 4500 ft, Sep, *M. A. Curtis 1310* (PH!, UARK!).

S. caesia var. *curtisii* (T. & G.) C. & J. Taylor. Sida 10:181. 1983. Superfluous name.

The decurrent leaves and striated stems are the distinctive characters. This variety is occasional in eastern Texas and is more common farther east. Taylor & Taylor (1983) contains further discussion of the species and its other varieties. $2n=18$ (Beaudry, 1963).

5. SOLIDAGO CANADENSIS L. Sp. Pl. 2:878. 1753. *Common Goldenrod*. Figs. 1, 4.

TYPE: Habitat in Virginia, Canada (LINN, Microfiche US!).

The branches of the inflorescence are usually secund, with pyramidal inflorescences. Leaves are pubescent on both sides. A weedy species occurring throughout Oklahoma and Texas where it is represented by several varieties. Ranked as the sixth most important forb in lowland prairies based on 135 areas from Kansas to South Dakota (Weaver, 1968). Key adapted from Croat (1972).

KEY TO VARIETIES

1. Inflorescence usually a compact pyramid, branches recurved; flowers secund; east of Trans-Pecos area.
 2. Involucre usually less than 2.8 mm high, disk flowers usually 3 or fewer (rarely 5), corollas less than 3 mm long var. *bargerii*
 2. Involucre more than 3 mm high; disk flowers more than 3, corolla longer than 3 mm.
 3. Plants usually more than 8 dm tall; leaves usually more than 7 cm long, pubescence on upper surface shorter and less dense than below; open areas in eastern forests var. *scabra*
 3. Plants usually less than 7 dm tall; leaves less than 7 cm long, pubescence nearly the same on both sides; prairies and flood-plains farther west var. *gilvocanescens*
1. Inflorescence typically elongate and scarcely secund and recurved; Trans-Pecos var. *salebrosa*

5a. var. GILVOCANESCENS Rydb. Contr. U.S. Natl. Herb. 3:162. 1895.

TYPE: NEBRASKA. Hooker Co.: sandy soil near water, Cody's Lakes, 10 Aug 1893, *Rydberg 1662* (HOLOTYPE: NY, microfiche DUR!; ISOTYPES: GH!, US!).

S. gilvocanescens (Rydb.) Smyth. Trans. Kansas Acad. Sci. 16:61 1899.

S. pruinosa Greene. Pittonia 4:70. 1899. TYPE: CANADA. SASKATCHEWAN, Moose Jaw, Assiniboia, 13 Aug 1895, *Macoun 10893, 10894* (CAN).

The differences between this variety and var. *scabra* are not clear cut, with many intermediates occurring. Generally the combination of shorter plants with smaller thicker leaves that are gray-green with uniform pubescence on both sides and with fewer teeth or even entire margins are the var.

gilvocanescens. This is the common variety of the tall grass prairies of the central portion of both states. It extends eastward along roadsides and other disturbed habitats, and westward up the floodplains of rivers and along wet roadsides, becoming established in irrigation facilities. It is capable of spreading in large clones over several acres. $2n=18, 36$ (Beaudry, 1963).

NOTE: *S. canadensis* var. *canescens* Gray, Proc. Amer. Acad. Arts 17:197. 1882. [*S. altissima* var. *canescens* (Gray) M. C. Johnst., Southw. Naturalist 14:372. 1970] is reported from southwest Texas based on collections by Berlandier, Lindheimer, Bigelow, and from southern New Mexico by Thurber. The description of narrow, entire leaves and its range indicate this plant is most likely not a variety of *S. canadensis* but of *S. velutina*. The type of this taxon has not been located.

5b. var. *HARGERI* Fern. Rhodora 17:11. 1914.

TYPE: CONNECTICUT. New Haven Co.: roadside near the Housatonic River at Bennett's Bridge, Southbury, 1 Oct 1901, *E. B. Harger s. n.* (HOLOTYPE: GH!).

The smaller heads are distinctive. However, measurements must be made on mature flower heads as young heads of other varieties can be mistaken for this taxon. Vegetative characters are similar to var. *scabra*. Mostly found in the eastern portion of coastal Texas, southeastern Oklahoma, and northern Oklahoma. $2n=18$ (Beaudry, 1959).

5c. var. *SCABRA* T. & G. Fl. N. Amer. 2:224. 1824.

TYPE: The type specimen may be a Muhlenberg specimen at PH which could be the plant that Muhlenberg described in his manuscript, Flora Lancastriensis, which Torr. & Gray redescribed as a new variety of *S. canadensis*. The Muhlenberg specimen at B, type of *S. scabra* Muhl. ex Willd., is *S. rugosa* and matches the description of Willdenow in Sp. Pl.

S. altissima L. Sp. Pl. 2:878. 1753. Habitat in America Septentrionale (LINN, Microfiche US!).

S. altissima var. *pluricephala* M. C. Johnst. Southw. Naturalist 14:372. 1970. TYPE: TEXAS. Cameron Co.: 15 Sep 1960, *R. J. Fleetwood* 3321 (HOLOTYPE: TEX).

This variety is not always readily separated from var. *gilvocanescens*. A combination of larger plants with large thin green leaves having a difference in density on the upper and lower leaf surfaces, with margins well toothed are good representatives of this taxon. This is the more commonly collected variety in eastern parts of Oklahoma and Texas. Despite the morphological gradation between varieties in this wide ranging species, there has been resistance to acceptance of this taxon at the varietal level. $2n=54$ reported as *S. altissima* from Dallas, Texas (Beaudry, 1963) and from elsewhere (Beaudry, 1959).

5d. var. *SALEBROSA* (Piper) Jones. Bull. Montana State Univ., Biol. Ser. 15:49. 1910.

- S. serotina* var. *salebrosa* Piper. Fl. Palouse Region 185. 1901. TYPE: WASHINGTON. Pullman, *Piper* 1580.
- S. elongata* Nutt. Trans. Amer. Philos. Soc. 7:327. 1841. TYPE: Wappatoo Island and plains of the Oregon (label: plains of the Columbia). *Nuttall* (LECTOTYPE: PH!).
- S. serra* Rydb. Bull. Torrey Bot. Club 31:650. 1905. TYPE: COLORADO. Yampa, *Shear & Bessey* 5274 (HOLOTYPE: NY, microfiche DUR!).
- S. polyphylla* Rydb. Bull. Torrey Bot. Club 31:651. 1905. TYPE: COLORADO. Canyon City, *Clements* 295 (HOLOTYPE: NY, microfiche DUR!).
- S. lepida* DC. var. *elongata* (Nutt.) Fern., *Rhodora* 17:9. 1915.
- S. canadensis* L. subsp. *salebrosa* (Piper) Keck, *Aliso* 4(1):104. 1958.

A western variety extending eastward in the United States to the Guadalupe-Davis Mountains in southwest Texas, it is sparsely pubescent as compared with other varieties, has thinner leaves, and mostly erect or only rarely recurved branches in the inflorescence.

6. SOLIDAGO GIGANTEA Ait.

Solidago gigantea is a mesic plant, most often occurring in wet roadside ditches, along floodplains, and adjacent to lakes and ponds. It begins blooming in midsummer but can continue late into the fall. Therefore, it can often have abnormal inflorescences coming from lateral branches. These are tall plants up to 1.5 m or more and can produce large clones from rhizomes or occur as single plants. The heads are about 6 mm high when mature.

KEY TO VARIETIES

1. Leaves glabrous var. *serotina*
 1. Leaves sparsely long pubescent on midrib of lower leaf surface ... var. *gigantea*

6a. var. GIGANTEA. Hortus Kew. 3:211. 1789. *Giant Goldenrod*. Figs. 1, 4.

TYPE: Based on a specimen from Kew Gardens originating in North America and cultivated 1758 by Mr. Philip Miller (BM).

S. serotina Ait. var. *gigantea* (Ait.) Gray. Syn. Fl. N. Amer. 2:156. 1884.

A rare plant in eastern Oklahoma and east Texas that is known only from a few collections (Taylor & Taylor, 1978). $2n=18, 36$ (Beaudry & Chabot, 1959, Beaudry, 1963).

6b. var. SEROTINA (Ait.) Cronq., Vasc. Plants Pacific Northwest 5:306. 1955.

S. serotina Ait. Hortus Kew. 3:211. 1789. TYPE: native of North America, flowering July, Aug. cultivated 1758 by Mr. Philip Miller (BM).

Aster latissimifolius (Mill.) O. Ktze. var. *serotinus* (Ait.) O. Ktze. Revis. Gen. Pl. 1:314. 1891.

S. pitcheri Nutt. J. Acad. Nat. Sci. Philadelphia 7:101, 102. 1834. TYPE: ARKANSAS TERRITORY [probably Ft. Gibson in present Oklahoma where Dr. Pitcher was stationed]. *Dr. Pitcher s.n.* (LECTOTYPE: PH!).

S. gigantea var. *leiphylla* Fern. *Rhodora* 41:457. 1939.

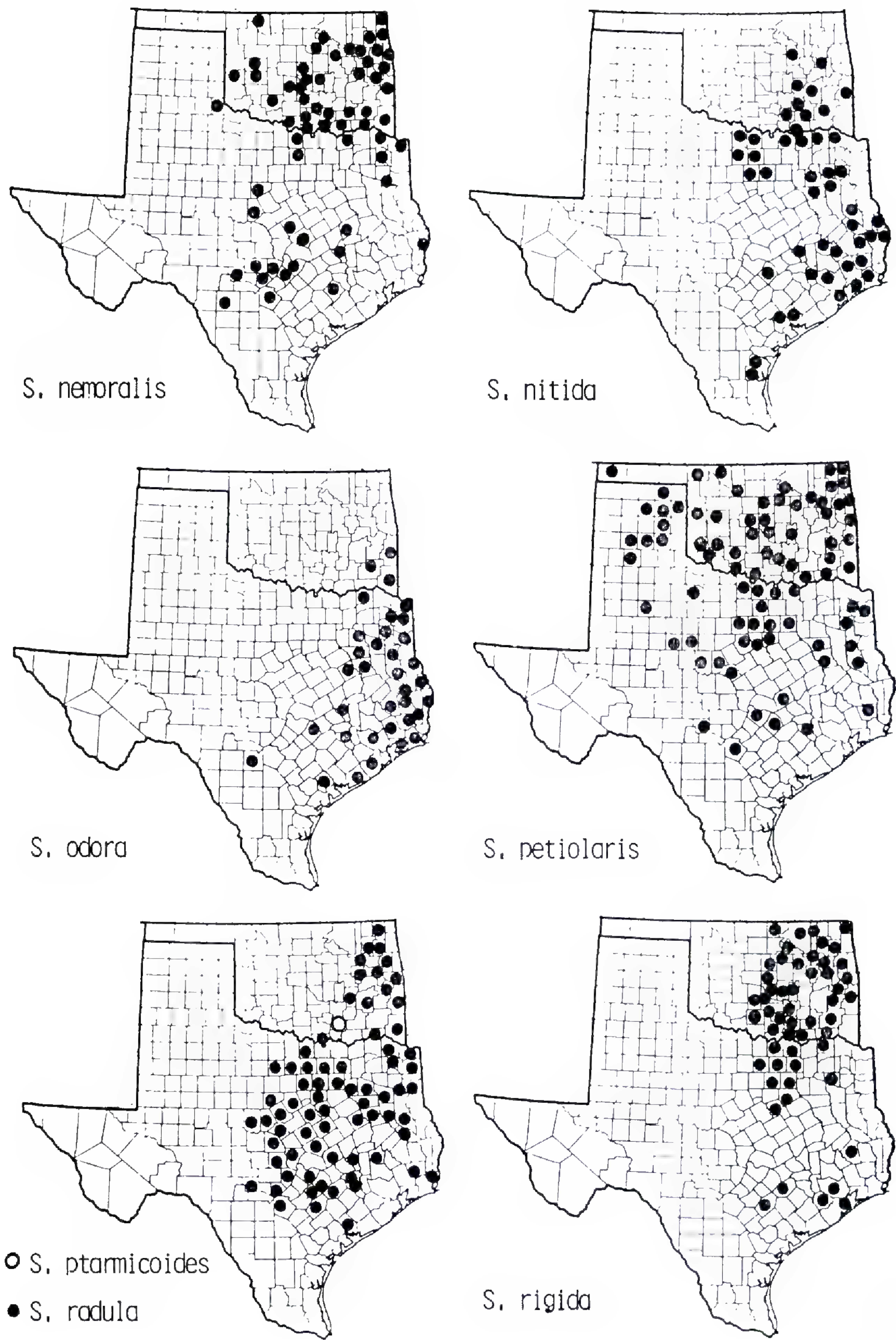


Figure 2.

A common goldenrod, usually with red stems, that blooms over a long season and frequently has atypical or abnormal inflorescences late in the season. This variety is most often confused with *S. missouriensis*, (especially those plants in southwestern Oklahoma and Texas that also have a pubescent inflorescence). *Solidago gigantea* has wider leaves that are uniform in width over a major portion of the leaf and are toothed along most of the leaf edge. *Solidago missouriensis* has smaller leaves, tapered at both ends and the teeth are fewer, smaller, and mostly apical. $2n=18, 36$ (Beaudry, 1963 reported as *S. g.* var. *leiophylla*; Beaudry & Chabot, 1959).

7. *SOLIDAGO HISPIDA* Muhl. ex Willd. Willdenow Sp. Pl. 3:2063. 1803.
Hispid Goldenrod. Figs. 1, 7,

TYPE: Habitat in Pennsylvania (Willdenow Collection, B, microfiche US!; ISOTYPE PH!).

S. bicolor L. var. *concolor* T. & G. Fl. N. Amer. 2:197. 1842. TYPE: KENTUCKY. [Lexington] *Dr. Short s.n.* (LECTOTYPE: GH!).

This occasional plant of the drier oak-hickory forests produces one or two stems per plant with a distinctive pilose pubescence. It is very closely related to *S. bicolor* which has white ray flowers. Though the taxa with different ray flower colors are considered as separate species, it is apparently the main character separating them. $2n=18$ (Beaudry & Chabot, 1959).

8. *SOLIDAGO MISSOURIENSIS* Nutt. var. *FASCICULATA* Holz. Contr. U.S. Natl. Herb. 1:208. 1892. *Missouri Basin Goldenrod*. Figs. 1, 4.

TYPE: INDIAN TERRITORY, Cherokee Outlet, Aug 1891, *W. A. Carlton* 430 (HOLOTYPE: US!).

This area is in northern Oklahoma and it extended from present Osage County west to Ellis and Harper counties. The type specimen at US had apical meristem damage, and the two stems have very narrow leaves which are not typical of undamaged plants.

Most plants growing in Oklahoma have a glabrous inflorescence, the character most often used in keys to separate this species from *S. gigantea*. But *S. missouriensis* plants in southwestern Oklahoma and Texas have a sparse pubescence in the inflorescence. There appears to be no other difference. Such sparse pubescence can also be found in specimens from the southwestern United States. Our variety of *S. missouriensis* differs from var. *missouriensis* in being taller than 20 cm and commonly with fastigate branching.

Weaver (1968) reported *S. missouriensis* to be a common member of upland prairies (ranking 6th among forbes) from Kansas to South Dakota, to increase under grazing, and to do better in drought years than most other prairie species. $2n=18$ reported for *S. missouriensis* (Beaudry, 1963; Beaudry & Chabot, 1959; Solbrig et al., 1964).

9. *SOLIDAGO MOLLIS* Bartl.

Rarely collected, this species of the high plains has small basal leaves which are generally absent at anthesis. Stem leaves are sessile, somewhat 3-ribbed, and mostly elliptic or oval to rarely obovate, with entire margins, and stem leaves imbricated. The pyramidal inflorescence and gray leaves often cause it to be mistaken for *S. canadensis* var. *glvocanescens* which usually has small teeth near the leaf tip and lateral veins which are straight. Actual leaf texture, pubescence, and head size reveal the close relationship of *S. mollis* with *S. radula*.

KEY TO VARIETIES

1. Leaves elliptic to oval; inflorescence pyramidal var. *mollis*
 1. Leaves narrowly obovate; inflorescence frequently longer than wide ... var. *angustata*

9a. *S. MOLLIS* Bartl. var. *MOLLIS*. Ind. Sem. Hort. Gotting. 5. 1836. *Northern Plains Goldenrod*. Figs. 1, 4.

TYPE: Based on a cultivated specimen, from seed collected by Prince Neu-wied, in the Botanic Garden of Halle.

In western Oklahoma, this variety has uniformly elliptic to broadly oval leaves. It has been rarely collected from gypsum outcrops or escarpments in western Oklahoma where it is at the southern end of its range. This plant is much more common in the northern short- and mid-grassland habitats of the High Plains.

9b. var. *ANGUSTATA* Shinnars. Field & Lab. 19:34. 1951.

TYPE: TEXAS, Wilbarger Co.: prairie along railroad track, 6 mi W of Electra on Hwy 287, 27 Oct 1945, *Whitehouse 10912* (SMU!).

Endemic to extreme south central Oklahoma and north central Texas (Hall, Wichita, Wilbarger cos., Texas; Jackson County, Oklahoma), this taxon appears to be intermediate between *S. mollis* and *S. radula*. The ranges of these two species meet in north central Texas. *Solidago radula* specimens often have similar leaves but usually have a much more divergent inflorescence, and leaf variation is from spatulate to broadly ovate to elliptic. The habitat of *S. radula* is dry rocky breaks and xeric roadsides and perhaps has been introduced into the eastern United States by way of the Red River valley. *Solidago mollis* var. *angustata* occurs in escarpment areas, particularly where gypsum is exposed and is confined to xeric habitats.

10. *SOLIDAGO NEMORALIS* Ait.

Solidago nemoralis grows in clumps of several stems and usually is found in drier upland sites in sunny locations. It is extremely variable in inflorescence and leaf shape, and a population along a roadside will be impressive in the differences of habit among individuals. This wide ranging eastern species usually has a basal rosette and persistent lower leaves which are

spathulate and entire to toothed. The lower leaves usually are over 5 times longer than wide and uniformly densely puberulent with short hairs. Only the midvein is apparent on leaves. $2n=18$ (Beaudry, 1963).

KEY TO VARIETIES

1. Main stem leaves oblanceolate to obovate, the upper gradually reduced in size, the lower ones of the stem 3–6 times as long as broad; involucre 3–4.5 mm high var. *nemoralis*
1. Main stem leaves linear-oblanceolate to linear, the lower ones 7–10 times as long as broad; involucre 4.5–6.5 mm high var. *longipetiolata*

10a. *S. NEMORALIS* Ait. var. *NEMORALIS*. Hortus Kew. 3:213. 1789. *Old-field Goldenrod*. Figs. 2, 4.

TYPE: Native of North America, introduced by Samuel Martin, M.D., Sept, 1769.

An eastern variety, this taxon extends to the eastern portions of Oklahoma and Texas. The type at GH of var. *haleana* Fern. has broad leaves but the inflorescence represents a very aberrant form not represented by any plants in our area; our branched inflorescence forms do not warrant taxonomic recognition.

10b. var. *LONGIPETIOLATA* (Mack. & Bush) Palmer & Steyer. Ann. Missouri Bot. Gard. 22:660. 1935.

S. longipetiolata Mack. & Bush. Trans. Acad. Sci. St. Louis 12:87. 1902. TYPE: MISSOURI. Jackson Co.: Lee's Summit, 9 Sep 1901, *Mackenzie* 425 (HOLOTYPE: NY, microfiche DUR!).

S. decemflora DC. Prodr. 5:332. 1836. TYPE: TEXAS in the eastern districts, *Berlandier*, 1824. (HOLOTYPE: G, microfiche US!; ISOTYPE: US!).

S. diffusa A. Nels. Bull. Torrey Bot. Club 25:378. 1898. TYPE: WYOMING. Badger, 27 Aug 1896, *Nelson* 2761 (RM).

S. pulcherrima A. Nels. Bull. Torrey Bot. Club 25:549. 1898. Based on *S. diffusa* A. Nels.

S. n. var. decemflora (DC). Fern. Rhodora 38:226. 1936.

In the western regions, this is the more common variety and the only variety in the northwestern United States and it is common in the northern Great Plains. The young flower heads are eaten by wild turkey, and the basal leaves are a source of food during winter for the white-tailed deer.

11. *SOLIDAGO NITIDA* T. & G. Fl. N. Amer. 2:210. 1842. *Flat-topped Goldenrod*. Figs. 2, 6.

TYPES: "Dry pine woods, western Louisiana, *Dr. Leavenworth!* *Dr. Hale!* and Texas, *Drummond!* *Dr. Leavenworth!*" Alexandria, Louisiana, *Dr. Hale* (LECTOTYPE NY, microfiche DUR!).

This summer-blooming goldenrod of the southeastern United States is distinctive with its flat-topped inflorescence and multiveined involucre bracts. It has, in the past, been placed in the genus *Oligoneuron* along with

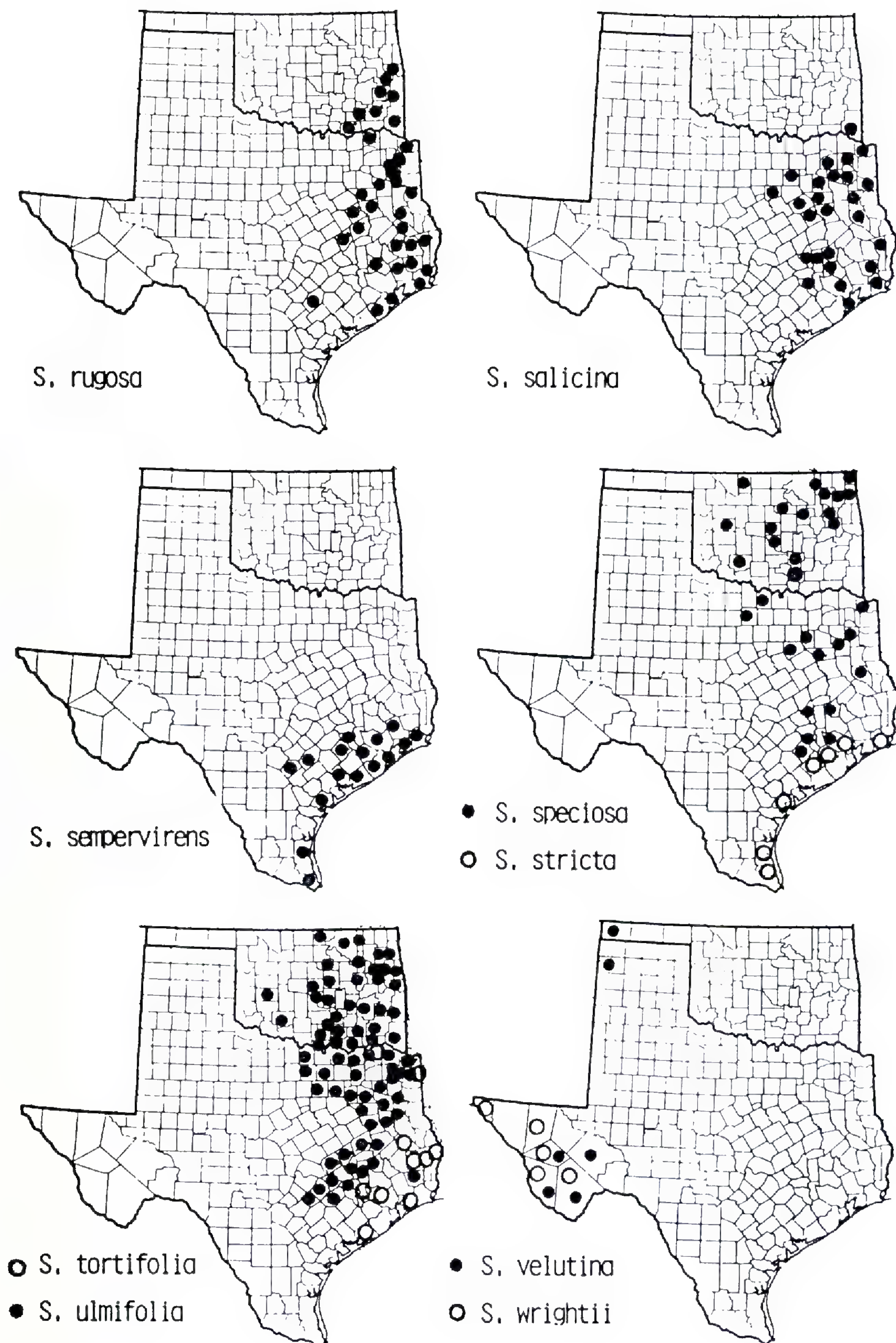


Figure 3.

related species. Recent work by Anderson & Creech (1975) indicates its closest alliance is with *Solidago*. It is confined to moist prairies and disturbed areas in eastern Oklahoma and eastern Texas. $2n=18$ (Cronquist, 1980).

12. *SOLIDAGO ODORA* Ait. Hortus Kew. 3:214. 1789. *Sweet Goldenrod*. Figs. 2, 4.

TYPE: Native of North America, cultivated by Mr. James Gordon, July, Aug, 1763.

S. puncticulata DC. Prodr. 5:332. 1836. TYPE: MEXICO. Rio de la Guadalupe, *Berlandier* (pl. exs. no. 1900). 1839 (G, US!).

The very narrow, small heads and glandular-dotted leaves are very distinctive. The leaves are glabrous and the stem has lines of hairs below the edge of the leaf attachment or is more pubescent with a glabrous area below the leaf node. A common plant along roadsides and in pine woods of the eastern portion of Texas, it barely extends into Oklahoma. Most plants have leaves with an anise odor when crushed and can be used for brewing tea.

13. *SOLIDAGO PETIOLARIS* Ait.

The heads of *S. petiolaris* are the largest of any of our goldenrods. Extremely large specimens have the lower larger leaves serrate. Growing in dense bunches with many stems, it does not spread by underground rhizomes into large clones. It is closely related to *S. wrightii* of southwestern Texas.

KEY TO VARIETIES

1. Leaves scarcely or not at all sticky or resinous, lower surface and main veins more or less hairy with spreading hairs; involucre bracts minutely hairy with hairs often sticky, but sometimes glabrous var. *petiolaris*
1. Leaves prominently sticky or resinous, lower surface glabrous; involucre glandular-dotted, essentially glabrous var. *angusta*

- 13a. *S. PETIOLARIS* Ait. var. *PETIOLARIS*. Hortus Kew. 3:216. 1789. Figs. 2, 7.

TYPE: Native of North America, cultivated by Mr. Philip Miller, Oct, Dec, 1758.

S. wardii Britt. Man. Fl. N. States. 935. 1901. TYPE: KANSAS. Clark Co.: 8 mi W of Ashland, 2 Oct 1897, *L. F. Ward s.n.* (GH!).

S. petiolaris var. *wardii* (Britt.) Fern. Rhodora 10:87. 1908.

Leaves are lanceolate to occasionally ovate. More common in the prairies and short grasslands of western regions. $2n=18$ (Beaudry, 1963).

- 13b. var. *ANGUSTA* (T. & G.) Gray. Proc. Amer. Acad. Arts 17:189. 1882.

S. angusta T. & G. Fl. N. Amer. 2:204. 1842. TYPE: Alexandria, western Louisiana, *Dr. Hale* [HOLOTYPE: NY, microfiche DUR!].

S. lindheimeriana Scheele. Linnaea 21:599. 1848. TYPE: Flora Texana exsiccata, Oct 1848, *Lindheimer* 417 (GH!, US!).

Generally more common in the eastern portions of Oklahoma and Texas, it is occasionally found in western regions.

14. *SOLIDAGO PTARMICOIDES* (Nees) Boivin. *Phytologia* 23:21. 1972. Figs. 2, 6.

Doellingeria ptarmicoides Nees. *Gen. Sp. Aster.* 183. 1832. Based on *Chrysopsis alba* Nutt. *Gen. N. Amer. Pl.* 2:152. 1818; not *S. alba* Miller.
Aster ptarmicoides (Nees) T. & G. *Fl. N. Amer.* 2: 160 1841.

A white-rayed species with flat-topped, loose, few-headed inflorescences and linear leaves known only in our region from the Baum Limestone area of southcentral Oklahoma, where it has evidently been introduced (Taylor & Taylor, 1978).

With the white rays and few heads, its overall aspect and habit are similar to *Aster*. Studies in leaf anatomy (Anderson & Creech, 1975) indicate this species is allied to the *Oligoneuron* section of *Solidago* from which it differs in having less prominent bundle sheath extensions.

15. *SOLIDAGO RADULA* Nutt. *J. Acad. Nat. Sci. Philadelphia* 7:102. 1834. Figs. 2, 4.

TYPE: ARKANSAS. (At the time of Nuttall's visit in 1819, the western boundary of Arkansas Territory was located 40 mi west of the present Oklahoma-Arkansas state line. He collected extensively in what is now southeastern Oklahoma).

- S. rotundifolia* DC. *Prodr.* 5:339. 1836. TYPE: Prov. Texas distr. orientalibus, *Berlandier* (pl. exs. n. 1884; G).
S. scaberrima T. & G. *Fl. N. Amer.* 2:221. 1842. TYPE: TEXAS. *Drummond*, Coll. III, No 138 (HOLOTYPE: NY, microfiche DUR!).
S. pendula Small. *Fl. SE U.S.* 1197, 1339. 1903. TYPE: ARKANSAS. Benton Co.: *Plank*, 1899 (HOLOTYPE: NY, microfiche DUR!).

Plants frequent in eastern area on dry bluffs and other xeric sites. Inflorescence is usually several-branched with the upper branches long and floriferous and the lower half with small, elliptic leaves. This is one of the few goldenrods in which the heads are not secund, but appear to equally surround the stem. This character is obvious in the field but may be distorted during pressing. Plants occur in clusters or bunches and are closely related to *S. mollis* with comments concerning relationship between these species under that species. It is not closely related to any of the other species of the eastern United States. $2n=18$ (Beaudry, 1963).

16. *SOLIDAGO RIGIDA* L. *Sp. Pl.* 2:880. 1753. Figs. 2, 6.

TYPE: "Habitat in Pennsylvania." The specimen in the Linnaean Herbarium consists of the upper part of a plant (LINN, microfiche US!).

- S. corymbosa* Ell. *Sketch Bot. S. Carolina* 2:378, 379. 1823. TYPE: GEORGIA. Louisville, Sep, Oct, Mr. Jackson s.n. *Not Poir. Encyc. Suppl.* 5:461. 1817.
S. rigida var. *humilis* Porter. *Syn. Fl. Colorado* 63. 1874. TYPES: COLORADO. Wet

- Mountain Valley *Brandege*, *Porter*; *Coulter*; near Denver, *Dr. Smith*. Not *S. humilis* of Miller, Pursh, or Desfontaines.
- Aster jacksonii* O. Ktze. Revis. Gen. Pl. 1:316. 1891.
- Oligoneuron rigidum* (L.) Small. Fl. SE U.S. 1188. 1903.
- O. canescens* Rydb. Bull. Torrey Bot. Club 31:652. 1904. Based on *S. rigida* var. *humilis* Porter.
- S. jacksonii* (O. Ktze.) Fern. Rhodora 38:229. 1936.
- S. canescens* (Rydb.) Friesner. Butler Univ. Bot. Studies 4:196. 1940.
- S. rigida* var. *glabrata* Braun. Rhodora 44:3. 1943. TYPE: KENTUCKY. Barren Co.: dry soil near Cave City, 11 Sep 1940, *Braun* 3629 (GH!).
- S. rigida* var. *laevicaulis* Shinn. Field & Lab. 19:35. 1951. TYPE: TEXAS. Dallas Co.: limestone soil, 2 mi N of Cedar Hill, 11 Nov 1947, *Whitehouse* 19269 (SMU!).
- S. jacksonii* var. *humilis* (Porter) Beaudry. Canad. J. Genet. & Cytol. 5:170. 1963.

The large heads, flat-topped inflorescence, and ovate leaves make this taxon distinctive. This is a wide ranging prairie and short grassland species occurring in the United States and Canada east of the Rocky Mountains.

As with most *Solidago* species, it varies from small to robust and from densely canescent to glabrate or more rarely glabrous. Beaudry (1963) divides this species into three entities. One species is the eastern pubescent robust tetraploid based on his counts from Almont, Penn., near the type location. The other smaller diploid plants, pubescent, glabrate, or glabrous represent a separate species with two varieties. The smaller glabrous taxon is regarded as *S. jacksonii* var. *jacksonii* (synonyms: *S. rigida* var. *glabrata* and *S. r.* var. *laevicaulis*). The pubescent plants which are the most common in the southern grasslands are referred to *S. jacksonii* var. *humilis*. Specimens of *S. rigida* in our area are just as robust as any from the eastern United States. Height and flower production varies considerably depending on availability of moisture, such as growing in a roadside ditch as opposed to growing on sloping ground above the ditch. Robustness, an environmental expression, is not a valid taxonomic character and this taxon should not be recognized as two separate species despite the tetraploidy of a few plants. $2n=18$ reported as *S. jacksonii* var. *jacksonii*, N Dallas, Texas (Beaudry, 1963).

17. SOLIDAGO RUGOSA Mill.

KEY TO VARIETIES

1. Leaves lanceolate, reticulation not pronounced beneath var. *rugosa*
 1. Leaves broadly lanceolate to ovate, reticulation pronounced beneath var. *aspera*

17a. *S. RUGOSA* Mill. var. *RUGOSA*. Gard. Dict. Ed. 8. species no. 25. 1768.
Rough-leaf Goldenrod. Figs. 3, 5.

TYPE: "Probably there is no type extant for *Solidago rugosa*." (Fernald, 1936).

S. scabra Muhl. ex Willd. Sp. Pl. 3(3): 2059. 1803. TYPE: *Muhlenberg* (B, microfiche 4201, US!).

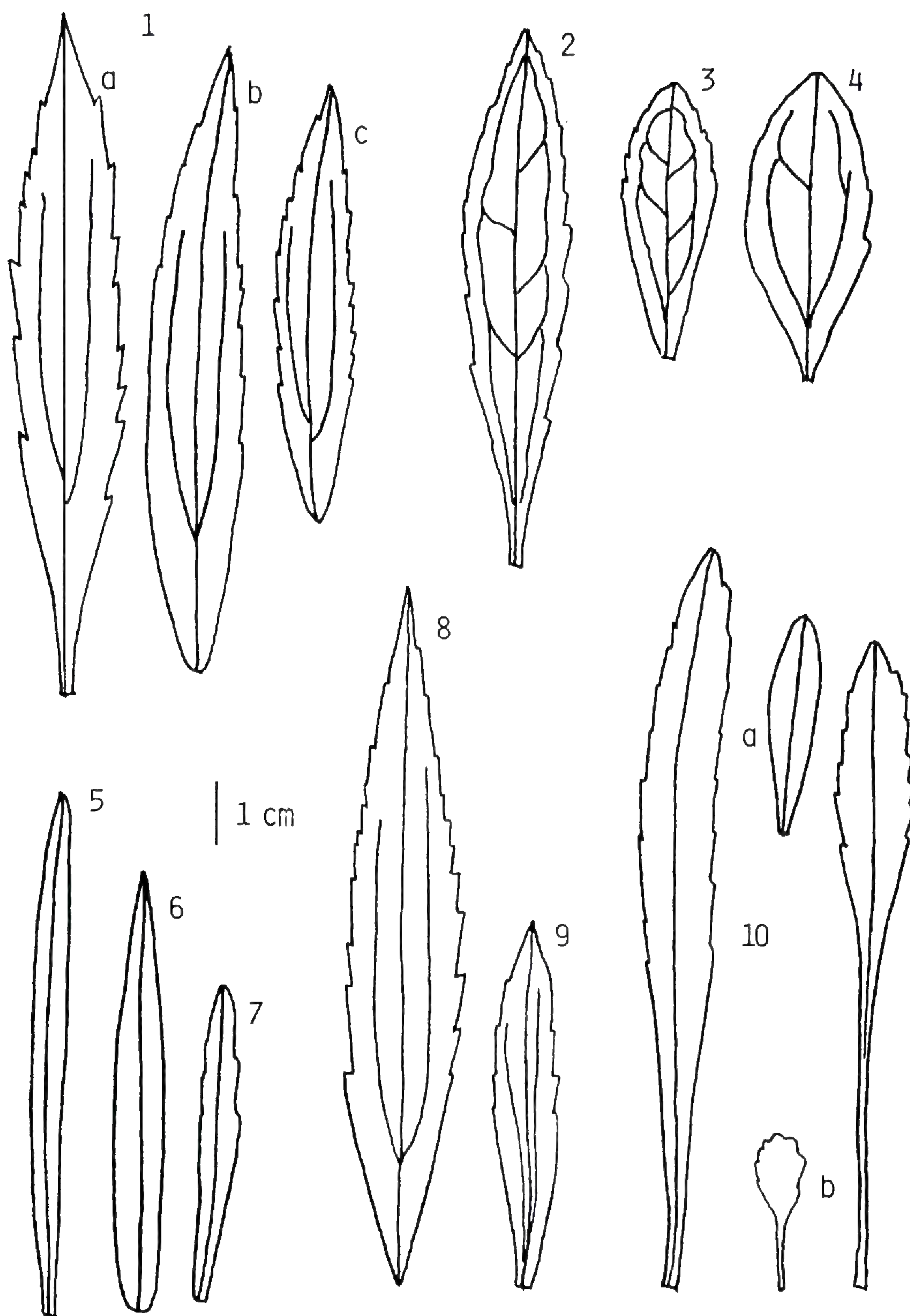


Figure 4. 1. *Solidago canadensis*, a. var. *scabra*, b. var. *gilvocanescens*, c. var. *salebrosa*; 2. *S. velutina*; 3. *S. radula*; 4. *S. mollis*; 5. *S. altiplanities*; 6. *S. odora*; 7. *S. tortifolia*; 8. *S. gigantea*, 9. *S. missouriensis*, 10. *S. nemoralis*, a. stem leaves, b. basal leaves.

Variety *rugosa* is a less frequently collected taxon which might be confused with *S. ulmifolia*. Generally, *S. rugosa* has a pubescent stem while *S. ulmifolia* has a glabrous stem. Occasionally plants have been seen that appear to be hybrids between the two species. In our area the species are sometimes sympatric, but they occur in different habitats. *Solidago rugosa* usually is found in roadside ditches and along streams and moist sites in oak-hickory forest while *S. ulmifolia* is confined to sunny openings in black-jack-post oak woods or dryer upland sites. *Solidago ulmifolia* blooms in the summer and has generally completed flowering when *S. rugosa* begins to flower.

17a. var. ASPERA (Ait.) Fern. Rhodora 17:7. 1915.

S. aspera Ait. Hortus Kew. 3:212. 1789. TYPE: Native of North America, cultivated, Sept, 1732 by James Sherard, M.D. (BM).

S. celtidifolia Small. Fl. SE U.S. 1198, 1339. 1903. TYPE: MISSISSIPPI. Biloxi, Tracy 5058 (HOLOTYPE: NY; photograph: Rhodora 38:227. 1936).

S. rugosa var. *celtidifolia* (Small) Fern. Rhodora 38:223. 1936.

A common variety in our area. Fernald (1936) has a rather complete discussion of the species, including pictures of type specimens. Plants with more lax inflorescences with a few prolonged divergent branches, floriferous past the middle, have been named var. *celtidifolia*, in contrast to compact inflorescences of var. *aspera*. Field studies in Oklahoma and Texas show that the inflorescences in a single, large and spreading clone of plants can vary from compact to widely branching. There is some difference in intensity of vein reticulation, and some leaves are obtuse apically instead of acute, but there is no correlation of characters. The recognition of var. *celtidifolia* is not warranted. $2n=18$ (Beaudry, 1953, Goodwin, 1937).

18. SOLIDAGO SALICINA Ell. Sketch Bot. S. Carolina 2:389. 1823. Figs. 3, 5.

TYPE: GEORGIA. Common in the oak land in the western districts, Sep-Oct.

S. patula Muhl. var. *strictula* T. & G. Fl. N. Amer. 2:213. 1842. TYPE: "North Carolina! to Florida! and Louisiana! Aug.-Sept."

S. boottii Hook. var. *ludoviciana* Gray. Syn. Fl. N. Amer. 2:154. 1884. TYPE: W. Louisiana, Hale s.n. (HOLOTYPE: GH!).

S. ludoviciana (Gray) Small. Fl. SE U.S. 1199, 1339. 1903.

This plant is very distinctive with its large size, long branches with very small leaves, and upper stem leaves appressed. Flowering stems are joined by underground rhizomes to basal rosettes of large and long petiolate leaves. Our plants are mostly glabrous on stems and leaves, but as is common in other goldenrods, many specimens occur with the upper surface of leaves scabrous. The glabrous forms have been referred to *S. ludoviciana*. Gary Morton (pers. comm.) has studied this taxon throughout its range in the eastern United States and has established its separate identity from *S. arguta* and *S. boottii*. Most of the Texas and Oklahoma plants are glabrous. Those

plants with upper leaf surfaces scabrous have been referred to *S. patula* var. *strictula*. Our own field and herbarium studies indicate they are the same entity, and the oldest name appears to be *S. salicina*. It has been found only twice in Oklahoma (Taylor & Taylor, 1978) but is weedy in east Texas.

19. SOLIDAGO SEMPERVIRENS L.

KEY TO VARIETIES

- 1. Lower inflorescence branches long, recurved, secund; leaves usually succulent, lanceolate, occurring in the inflorescence; width of leaf just below inflorescence (0.5) 1.1 (1.8) cm var. *mexicana*
- 1. Lower inflorescence branches erect; leaves less succulent, narrowly lanceolate, not occurring in inflorescence; width of leaf just below inflorescence (0.3) 0.5 (0.8) cm var. *sempervirens*

19a. *S. SEMPERVIRENS* L. var. *SEMPERVIRENS*. Sp. Pl. 2:878. 1753. *Seaside Goldenrod*. Figs. 3, 6.

TYPE: "Solidago maritima, habitat in Noveboraceo, Canada." Specimen in LINN consists of two stems in early bud and with lower stem leaves (Microfiche US!).

Our plants simply reflect a southern growth pattern of the northern plants, ours being taller and blooming later. Plants are somewhat pubescent in the inflorescence. It is fairly common inland from the coast. Most plants of this variety have been placed into the var. *mexicana* or have passed under the name *S. stricta*, a closely related taxon. The var. *sempervirens* is much more readily separated from var. *mexicana* than it is from *S. stricta* with which it is reported to hybridize (Cronquist, 1980). The latter has appressed, smaller, upper stem leaves and glabrous inflorescences.

19b. var. *MEXICANA* (L.) Fern. Rhodora 37:447. 1935.

S. mexicana L. Sp. Pl. 2: 879. 1753. TYPE: Mexico. (LINN, microfiche US!).

This is the more common variety in dune habitats. Studies (Cartica and Quinn, 1980) show succulence of leaves varies in relation to intensity of salt application. The considerable variation expressed by this species thus reflects whether it is a primary dune plant exposed to high amounts of salt spray, or exposed to decreasing amounts in marshes farther inland. This species is confined to the coastal area of Texas.

20. SOLIDAGO SPECIOSA Nutt.

KEY TO VARIETIES

- 1. Midstem leaves over 2 cm wide; lower leaves usually persistent var. *speciosa*
- 1. Midstem leaves less than 2 cm wide; lower leaves usually deciduous var. *rigidiuscula*

20a. *S. SPECIOSA* Nutt. var. *SPECIOSA*. Gen. N. Amer. Pl. 2:160. 1818. *Prairie Goldenrod*. Figs. 3, 7.

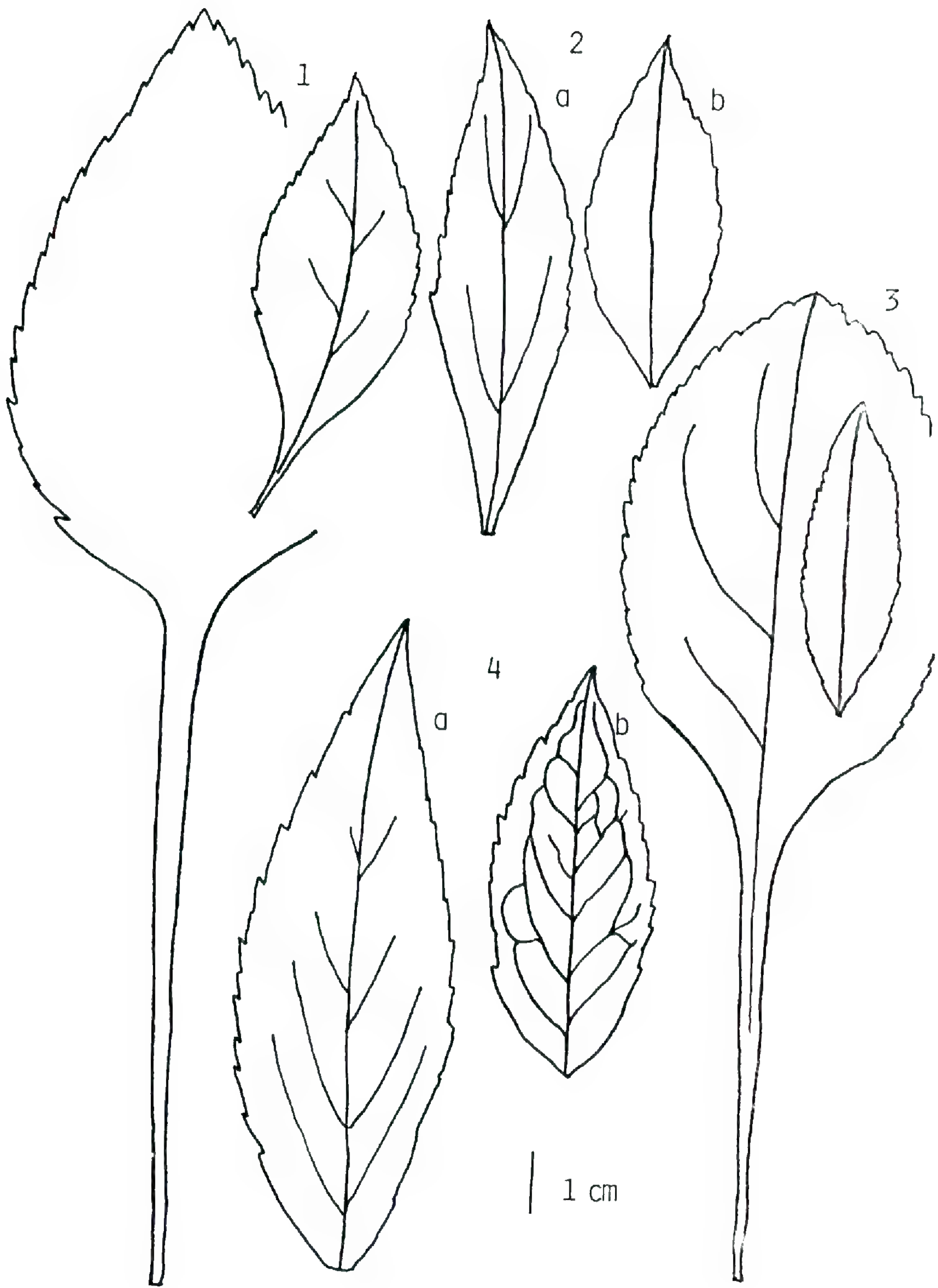


Figure 5. 1. *Solidago arguta*, basal and stem leaves; 2. *S. ulmifolia* a. var. *ulmifolia*, b. var. *microphylla*; 3. *S. salicina*, basal and stem leaves; 4. *S. rugosa*, a. var. *rugosa*, b. var. *aspera*.

TYPE: Habitat in shady woods on banks of the Schuylkill, also in New Jersey; near Philadelphia. (HOLOTYPE: PH!).

Specimens of this variety have been collected in northeastern Oklahoma (Adair County).

20b. var. *RIGIDIUSCULA* T. & G. Fl. N. Amer. 2:205. 1842.

TYPE: "St. Louis, Missouri and Texas, *Drummond!* *Dr. Engelmann!*; Louisiana, *Dr. Leavenworth!*; Prairies between the Mississippi and Missouri rivers, *Mr. Nicolle!*"

S. rigidiuscula (T. & G.) Porter. Mem. Torrey Bot. Club 5:319. 1894.

S. venulosa Greene. Pittonia 5:138. 1903. TYPE: TEXAS. Palo Pinto Co.: dry hills near Weatherford, 18 Oct 1902, *Tracy* 3803 (US!).

S. chandonnettii Steele. Contr. U.S. Natl. Herb. 16:222. 1913. TYPE: MINNESOTA. Ottertail Co.: dry sandy soils, prairie, Perham, 6 Aug 1912, *Chandonnet s.n.* (US!).

A bunched plant of few to several stems that can become a dominant member of prairies. Its present infrequency seems to be due to a decline in native prairies in the midwest.

21. *SOLIDAGO STRICTA* Ait. Hortus Kew. 3:216 1789 *Seaside Goldenrod*. Figs. 3, 6.

TYPE: Native of North America, cultivated, Sept, 1758 by Mr. Philip Miller (BM).

These wetland to marsh plants are restricted to the coastal zone. A slender plant, with erect narrow inflorescence and small, erect, upper stem leaves that are appressed, is very closely related to *S. sempervirens* and is reported to hybridize with it (Cronquist, 1980). Measurements by Boettcher (1980) clearly show the morphological overlap with *S. stricta* measurements clustering around the smaller sizes. Even more interesting is his composite flavonoid profiles showing close correlation between *S. stricta* and *S. confinis* of the west coast and its submersion in the more diverse profile exhibited by *S. sempervirens*. While its morphological variation indicates submersion in *S. sempervirens*, Boettcher and Cronquist both maintain *S. stricta* as a separate hexaploid species with $2n=54$.

22. *SOLIDAGO TORTIFOLIA* Ell. Sketch Bot. S. Carolina 2:377. 1823. *Twisted Leaf Goldenrod*. Figs. 3, 4.

TYPE: Based on *S. odora* of Michx. Fl. Bor. Amer. 2:118. 1803, not Ait., Hortus Kew. 3:214. 1789. "Hab. in Carolina inferiorae," (Willdenow collection, at B, microfiche US!).

Closely allied to *S. odora*, this few-flowered, small-headed goldenrod has pubescent stems and is moderate to densely scabrous on midrib and upper leaf surfaces. Leaves are often twisted. Overall, its characters cluster toward the smaller measurements in leaf size and inflorescence (leaf width about 4

mm, leaf length 3.5–4 cm). Internodes are 5 mm long while those of *S. odora* are about 11 mm long. Many specimens appear to be morphologically intermediate in size and pubescence, at least in our area where the plants are much larger than those from Florida. $n=9$ (Cronquist, 1980).

23. *SOLIDAGO ULMIFOLIA* Muhl. ex Willd.

KEY TO VARIETIES

- 1. Leaves ovate; lower inflorescence branches long, floriferous apically
.....var. *microphylla*
- 1. Leaves ovate to lanceolate; inflorescence pyramidal, branches not long
and leafy var. *ulmifolia*

23a. *S. ULMIFOLIA* var. *ULMIFOLIA*. Muhl. ex Willd. Sp. Pl. Ed. 4. 2060. 1803. *Elm-leaf Goldenrod*.

TYPE: Habitat eastern United States, Muhlenberg specimen (B, microfiche US!; ISOTYPE: PH!).

Variety *ulmifolia* is the common variety of the northeastern United States and is occasionally found in northeastern Oklahoma in oak-hickory forests. Plants are usually glabrous, but some can be found with pubescence on the leaves. The primary stem is glabrous, while that of the closely related *S. rugosa* is pubescent. However, the extremely pubescent *S. ulmifolia* var. *palmeri* Cronq. with pilose stems has been collected in the Ouachita Mountains just east of the Oklahoma state line. $2n=18$ (Beaudry, 1969).

23b. var. *MICROPHYLLA* Gray. Proc. Amer. Acad. Arts 17:194. 1882.

S. microphylla (Gray) Engelm. ex Small. Fl. SE U.S. 1198. 1903. TYPE: No specimen citations.

S. delicatula Small. Bull. Torrey Bot. Club 25:474. 1898. TYPE: TEXAS. [Lamar County], prairies near Paris, *J. S. Merriam s.n.* 1872 (LECTOTYPE & ISOTYPE: NY, microfiche DUR!).

S. helleri Small. Bull. Torrey Bot. Club 25:619, 620. 1898. TYPE: TEXAS. Bowie Co.: near Texarkana, 2 Sept 1898. *A. A. & E. G. Heller 4188* (HOLOTYPE: NY, microfiche DUR!; ISOTYPES: PH!, US!).

This is the most common variety. The shape of the leaves has caused this plant to be confused with *S. arguta* var. *boottii* which also has elm-shaped leaves and long lower inflorescence branches. See further comments under *S. arguta*. Our plants never have a basal rosette and lower leaves are deciduous at flowering. In our area it is mostly found growing in openings and along roadsides in the blackjack-post oak forest on drier sites. Usually it is found only where both sun and shade occur during the day. $2n=18$ from Dallas, Texas (Beaudry, 1963).

24. *SOLIDAGO VELUTINA* DC. var. *NEVADENSIS* (Gray) C. & J. Taylor, comb. nov. *Velvety Foothills Goldenrod*. Figs. 3, 4.

S. californica Nutt. var. *nevadensis* Gray. Botany Calif. 1:319. 1876. TYPE: NEVADA. Carson City, 1865, *Anderson s.n.* (HOLOTYPE: GH!).

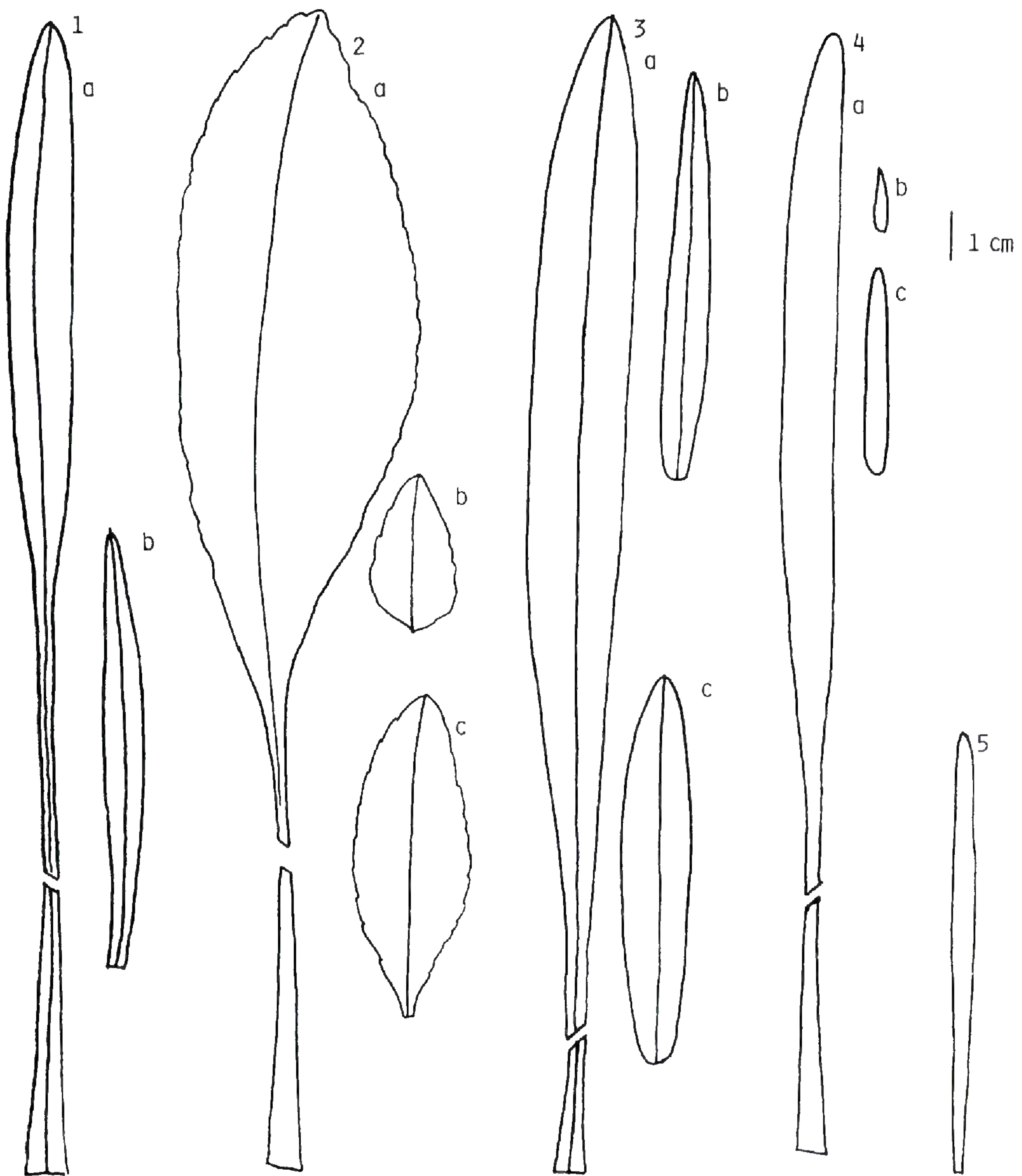


Figure 6. 1. *Solidago nitida*, a basal leaf, b. stem leaf; 2. *S. rigida*, a. basal leaf, b. & c. stem leaves; 3. *S. sempervirens*, a. basal leaf, b. var. *sempervirens*, stem leaf; c. var. *mexicana*, stem leaf; 4. *S. stricta*, a. basal leaf, b. & c. stem leaves; 5. *S. ptarmicoides*, stem leaf.

- S. sparsiflora* Gray. Proc. Amer. Acad. Arts. 12:58. 1874. TYPE: ARIZONA. Camp. Lowell, 1874, *Dr. Rothrock* 706 (HOLOTYPE: GH!, ISOTYPE: US!).
- S. canadensis* L. var. *arizonica* Gray. Proc. Amer. Acad. Arts. 17:197. 1882. TYPE: ARIZONA. Boulder Creek, elev 4500 ft, 1874, *Rothrock* 782 (HOLOTYPE: GH!; ISOTYPE: US!).
- S. trinervata* Greene. Pittonia 3:100. 1896. TYPE: COLORADO. Gunnison Canyon, 18 Aug 1896, *E. L. Greene s.n.* (LECTOTYPE: ND!).
- S. arizonica* (Gray) Woot. & Standl. Contr. U.S. Natl. Herb. 16:181. 1913.
- S. howellii* Woot. & Standl. Contr. U.S. Natl. Herb. 16:181, 182. 1913. TYPE: NEW MEXICO. Sierra Grande, 15 Aug 1903, *Howell* 219 (HOLOTYPE: US!).

This taxon varies considerably in morphology. Leaves vary from widely lanceolate to nearly spatulate with margins sparsely toothed to entire while leaf pubescence is very dense to sparse. The inflorescence can be a compact pyramid to a more open pyramid with the lower branches floriferous only toward the tips. Grazing and drought can cause apical meristem damage giving rise to atypical inflorescences. Our plants represent the eastern edge of the range of *S. velutina*, which was originally collected from the Pacific Coast of Mexico. This species is closely allied with *S. mollis* and *S. radula* of the eastern United States and with *S. californica*, and is one of the more common goldenrods of Mexico. In our area it is found only in extreme southwestern Texas with a single known population in northwest Texas and from the Black Mesa region of Oklahoma. Its habitat is the semi-arid foothills of the Rocky Mountains.

25. SOLIDAGO WRIGHTII Gray.

The extensive variation in this taxon has been discussed by Taylor & Taylor (1983). It was originally separated into varieties based on glandular or eglandular pubescence, but the inflorescence shape and number of heads appear to be more important. This species, which is closely allied to *S. petiolaris* of the eastern United States, needs more study.

KEY TO VARIETIES

- 1. Heads cymose, singular or few on long pedicels forming a flat-topped inflorescence var. *wrightii*
- 1. Heads paniculate, lower branches of inflorescence leafy, flowers clustered apically var. *adenophora*

25a. *S. WRIGHTII* Gray var. *WRIGHTII*. Proc. Amer. Acad. Arts. 16:80. 1880. *Wright's Goldenrod*. Figs. 3, 7.

TYPE: TEXAS. Mountains between the Limpia and Rio Grande, Aug, 1849, *Wright* 281 (Gray's assigned no.); Arizona. Mt. Graham, alt 9000 ft, *Rothrock* 730 (GH!, US!).

S. bigelovii var. *wrightii* Gray. Proc. Amer. Acad. Arts. 17:190. 1882.

Both *S. bigelovii* and *S. wrightii* specimens available to Gray had moderately dense nonglandular pubescence. The few heads and flat-topped appearance make this an unusual goldenrod.

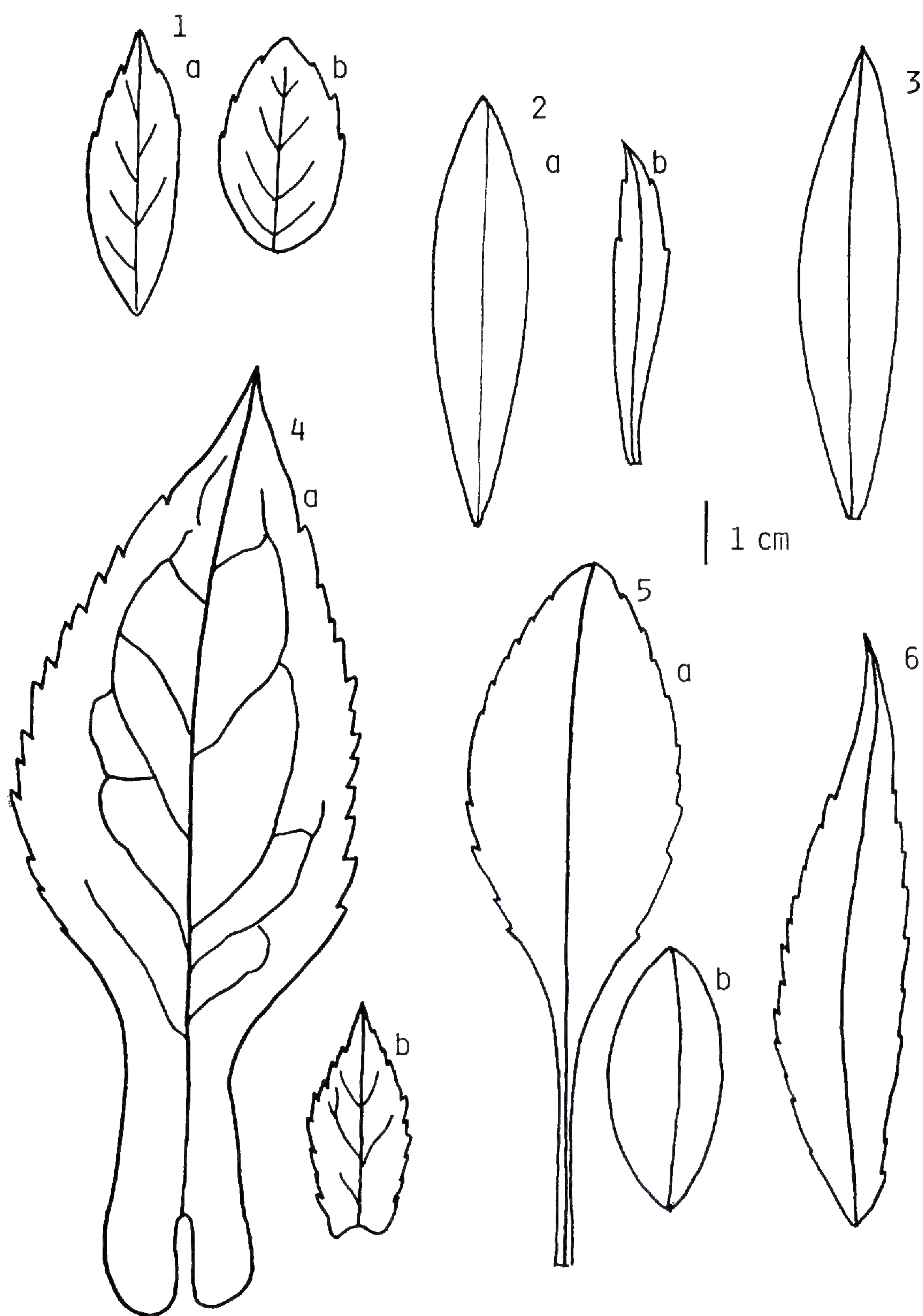


Figure 7. 1. *Solidago petiolaris*, a. var. *angustata*, b. var. *petiolaris*; 2. *S. wrightii*, a. & b. show leaf variation; 3. *S. speciosa*; 4. *S. auriculata*, a. lower stem leaf, b. upper stem leaf; 5. *S. hispida*, a. basal leaf, b. stem leaf; 6. *S. caesia*, stem leaf.

25b. var. ADENOPHORA Blake. J. Wash. Acad. Sci. 19:269. 1929.

TYPE: ARIZONA. Mt. Lemmon, 7500 ft, 4 Aug 1926 *Harrison* 3016 (US!).

S. bigelovii Gray. Proc. Amer. Acad. Arts. 17:190. 1882. TYPE: NEW MEXICO. Coppermincs, 1851, *Wright* 1182 (PH!, US!).

This variety was described by Blake with its emphasis on the abundance of glandular pubescence. However, both glandular and eglandular morphological forms may be found. Leaf variations does not correlate with inflorescence type or pubescence type.

ERRATA AND EXCLUDED SPECIES

In a previous article, Taylor & Taylor (1983), there are two typographical errors concerning dates of publication: *S. caesia* var. *hispida* published in 1845, and *S. flaccidifolia* published in 1898. L. J. Uttal was kind enough to point out that *S. caesia* L. var. *curtisii* had already been made by Wood in his Class-book of Botany.

Excluded species: *Solidago flexicaulis* L. was reported as occurring in McCurtain County, Oklahoma (Taylor & Taylor, 1978).

ACKNOWLEDGEMENTS

A collection of over 2,000 specimens of *Solidago* has been acquired from throughout the North American range of the genus (DUR). We wish to thank the curators of the following herbaria who allowed us use of their facilities and/or loan of specimens: ALA, ASTC, ASU, CS, CSU, ECSU, GH, KSTC, MIN, MO, MONT, ND, NEOSU at Talequah, Oklahoma, NLU, NO, NWOSU at Alva, Oklahoma, OCLA, OKL, OKLA, OLDS, OSC, PENN, PH, RM, SAT, SFRP, SRSC, SMU, TAES, TEX, TTC, TULS, UAC, UARK, US, UT, and WTS. The American Association of University Women enabled the senior author to examine over 200 type specimens. Photographs of all types examined are at DUR. Microfiche of NY types are also at SMU. Special thanks are given to Wm. F. Mahler, Barney L. Lipscomb, and Paul A. Fryxell for their help in resolving some of the numerous nomenclatural problems, and to George J. Goodman who encouraged our studies in this difficult genus.

REFERENCES

- ANDERSON, L. C. and J. B. CREECH. 1975. Comparative leaf anatomy of *Solidago* and related Asteraceae. Amer. J. Bot. 62:486-493.
- BEAUDRY, J. R. 1960. Studies on *Solidago* L. V: the *Solidago rugosa* complex. Canad. J. Genet. Cytol. 2:389-396.
- . 1963. Studies on *Solidago* L. VI: additional chromosome numbers of taxa of the genus *Solidago*. Canad. J. Genet. Cytol. 5:150-174.
- . 1968. Etudes sur les *Solidago* L. VIII: resultats et analyse de croisements effectues entre le *Solidago canadensis* L. et le *Solidago lepida* var. *fallax* Fern. Naturaliste Canad. 95:19-37.
- . 1969. Etudes sur les *Solidago* L. IX: une troisieme liste de nombres

- chromosomiques des taxons du genre *Solidago* et de certains genres voisins. *Naturaliste Canad.* 96:103–122.
- BEAUDRY, J. R. and D. L. CHABOT. 1959. Studies on *Solidago* L. IV: the chromosome numbers of certain taxa of the genus *Solidago*. *Canad. J. Bot.* 37:209–228.
- BEAUDRY, J. R., A. ZINGER, and J. SAINT-PIERRE. 1958. Etudes sur le genre *Solidago* L. II: la mise en evidence de la polyploidie endotaxonomique chez *S. purshii* Porter et les taxa similaires. *Canad. J. Bot.* 36:663–670.
- BOETTCHER, R. C. 1980. A systematic study of the *Solidago sempervirens* L. (Compositae) complex. Master's Thesis. Louisiana State University & Agric. & Mechanical College, Baton Rouge.
- BROUILLET, L. and J. SEMPLE. 1981. A propos du status taxonomique de *Solidago ptarmicoides*. *Canad. J. Bot.* 59:17–21.
- CARTICA, R. J. and J. A. QUINN. 1980. Responses of populations of *Solidago sempervirens* (Compositae) to salt spray across a barrier beach. *Amer. J. Bot.* 67(8):1236–1242.
- CORRELL, D. S. and M. C. JOHNSTON. 1970. Manual of the vascular plants of Texas. Texas Research Foundation, Renner, Texas.
- CROAT, T. 1972. *Solidago canadensis* complex of the Great Plains. *Brittonia* 24: 317–327.
- CRONQUIST, A. 1980. Vascular flora of the southeastern United States I. *Asteraceae*. University North Carolina Press, Chapel Hill.
- FERNALD, M. L. 1936. Contributions from the Gray Herbarium of Harvard University—No. CXIII: VI. Studies in *Solidago*. *Rhodora* 38:201–229.
- GOODWIN, R. W. 1937. The cytogenetics of two species of *Solidago* and its bearing on their polymorphy in nature. *Amer. J. Bot.* 24:425–432.
- GRAY, A. 1882. Studies of *Aster* and *Solidago* in the older herbaria. *Proc. Amer. Acad. Arts.* 17:177–189.
- . 1884. Synoptic flora North America. 1:143–161.
- JACKSON, B. D. 1895. Index Kewensis: an enumeration of genera and species of flowering plants. Clarendon Press, Oxford, England.
- KAPOOR, B. M. and J. R. BEAUDRY. 1966. Studies on *Solidago* L. VII: the taxonomic status of the taxa *Brachychaeta*, *Brintonia*, *Chrysoma*, *Euthamia*, *Oligoneuron*, and *Petradoria* in relation to *Solidago*. *Canad. J. Genet. Cytol.* 8:422–443.
- KARTESZ, J. T. and R. KARTESZ. 1980. A synonymized checklist of the vascular flora of the United States, Canada, and Greenland. University of North Carolina Press, Chapel Hill.
- SEMPLÉ, J. C., R. A. BRAMMALL, and J. CHMIELEWSKI. 1981. Chromosome number of goldenrods, *Euthamia* and *Solidago* (Compositae-Astereae). *Canad. J. Bot.* 59:1167–1173.
- SIEREN, D. J. 1970. A taxonomic revision of the genus *Euthamia*. Ph.D. Dissertation, University of Illinois, Urbana.
- SOIL CONSERVATION SERVICE. 1981. National list of scientific plant names, Vol. I. U.S. Dept. of Agric. SCS-TP-159. U.S. Printing Office, Washington, D.C.
- SOLBRIG, O. T., L. C. ANDERSON, D. W. KYHOS, P. H. RAVEN, and L. RUDENBERG. 1964. Chromosome numbers in Compositae V. Astereae II. *Amer. J. Bot.* 51:513–520.
- TAYLOR, R. J. and C. E. TAYLOR. 1978. Additions to the vascular flora of Oklahoma. *Sida* 7:361–368.
- . 1983. New species, new combinations, and notes on the goldenrods (*Euthamia* and *Solidago*—Asteraceae). *Sida* 10:176–183.
- TAYLOR, R. J., C. E. TAYLOR, and J. SANDIDGE. 1978. Plants new to the Oklahoma flora. *SE Oklahoma State Univ. Publ.* 2:8–14.
- WEAVER, J. E. 1968. Prairie plants and their environment. University of Nebraska Press, Lincoln.

NOTES

THE DEMOULIN RULE IN NOMENCLATURE—James Reveal (Taxon 32:292–295. 1983) pointed out the problems caused by a change in the Code made at the Congress in Sydney. "The Demoulin Rule," so designated by Reveal, states that "An autonym will automatically acquire priority over the name of equivalent rank which has established it." This changes Arts. 19.4, 22.2, and 26.2 and may lead to numerous and very unfortunate changes. One example is in *Calycanthus*. The glabrous variety of *C. floridus* has generally been called *C. floridus* var. *laevigatus* (Willd.) T. & G. (1840) following the treatment by Nicely (Castanea 30:38–81. 1965). In 1981, Boufford and Spongberg (J. Arnold Arbor. 62:265–266) called attention to an earlier available varietal epithet (*C. glaucus* var. *oblongifolius* Nutt. 1818) and made the new combination *C. floridus* var. *oblongifolius* (Nutt.) Boufford & Spongberg. Now, following this new rule, their combination is superfluous, for the autonym *glaucus*, established when *oblongifolius* was named and based on *C. glaucus* Willd., has priority. Fortunately, the combination *C. floridus* var. *glaucus* (Willd.) T. & G. was made in 1840 and a new combination is not necessary.

Such changes, however, are not as automatic as they may appear, for one must be certain of the taxonomy and synonymy of the specific case before any changes are made. For example, *Quercus minor* var. *margaretta* Ashe is the basionym for the commonly used *Q. stellata* var. *margaretta* (Ashe) Sarg. Should the varietal epithet (autonym) *minor* replace *margaretta* in this case? No, for *Q. minor* (Marsh.) Sarg. is a taxonomic synonym of *Q. stellata* var. *stellata* and not *Q. stellata* var. *margaretta*. There is a similar case in *Aesculus*. The yellow-flowered *A. pavia* on the Edwards Plateau of Texas, designated as *A. pavia* var. *flavescens* (Sarg.) Correll, has the basionym *A. discolor* var. *flavescens* Sarg. But, *A. discolor* var. *discolor* is a synonym of *A. pavia* var. *pavia* and no change is needed.

The best solution, for sake of nomenclatural stability, would be to eliminate this destabilizing rule completely, as proposed by Johnston (Taxon 33:124–125. 1984).—James W. Hardin, Department of Botany, North Carolina State University, Raleigh, NC 27650, U.S.A.

IPOMOEA DUMETORUM (CONVOLVULACEAE): AN AMPHI-TROPICAL DISJUNCT MORNING GLORY IN THE SOUTHWEST U.S.—Amphitropical disjuncts and their modes of origin have been reviewed by various authors (Raven, 1963; Moore, 1972; Solbrig, 1973), although such reports have not included reference to species of *Ipomoea*. In the course of studies on New World Convolvulaceae, a common weed of the central Andean highlands, *I. dumetorum* Willd. ex Roem. ex Schult., was discovered as a rare plant in the mountains of Doña Ana and Lincoln coun-

ties, New Mexico, and in Davis County, Texas. *Ipomoea dumetorum* is a montane annual commonly found from 2000 to 3300 m in Argentina, Bolivia, Perú, Ecuador, and Columbia (fig. 1). House (1908) and O'Donell (1941) also recognized the occurrence of the species in México, both citing a single collection from Sierra San Felipe, Oaxaca. Neither author, however, was aware of U.S. populations, nor of other scanty and widely disjunct Mexican populations near San Luis Potosí and in the Valley of México. Hitherto the present report, the latter populations have been consistently misidentified as *I. cardiophylla* Gray, a distantly related Chihuahuan desert endemic. *Ipomoea dumetorum* is easily distinguished by lavender corollas, dark-glandular sepals, and a preference for altitudes above 2000 m.

The earliest U.S. collections of *I. dumetorum* came from the Organ and White Mountains of New Mexico (1897–1907), with more recent collections (1935, 1947, 1968) from Mt. Livermore of the Davis Mountains, Texas. The following selected specimens extended the previously known range of this poorly known morning glory:

Specimens examined:

MÉXICO. MÉXICO: Valley de Mexico, Zacoalco, 28 Aug 1866, *Bourgeau* 796 (US); SAN LUIS POTOSÍ: near San Luis Potosí, 1876, *Schaffner* 620 (GH). OAXACA: Cerro San Felipe, 2000 m, 18 Oct 1908, *Conzatti* 2274 (US). UNITED STATES. NEW MEXICO. Lincoln Co.: White Mts., 2300 m, 14 Aug 1897, *Wootton* 630 (NY); Doña Ana Co.: Organ Mts., Filmore Canyon, 2500 m, 11 Sep 1980, *McDonald* 140 (TEX). Texas. Jeff Davis Co.: Davis Mts., Mt. Livermore, South slope, 13 Aug 1935, *Hinckley* 322 (NY); Jeff Davis Co.: Davis Mts., Mt. Livermore, above upper stream in Madera Canyon, 11 Sep 1947, *Warnock & Hinckley* 7452 (SR).

Habitat preferences for the above populations are similar to those reported in South America: cool, xeric, seasonally wet open areas at elevations of 2600–2800 m. I have observed North American populations blooming and fruiting from August to October in association with *Fallugia*-dominated communities, preferring washes and alluvial soils derived from igneous rock.

Although disjunct populations of *I. dumetorum* in North America might be explained, in part, by migrations through pleistocene climatic influences, disjunct patterns across continents or widely separated mountain peaks (e.g., Cerro San Felipe, Oaxaca, and Mt. Livermore, Texas) may have involved incidents of long distance dispersal. The functional disseminules of *I. dumetorum* are its small (3–4 mm long), dark rotund seeds. These seeds are too heavy for significant wind dispersal, and lack means of attachment for external animal dispersal. However, they possess a relatively thick seed coat, making possible their ingestion and transport by birds. Much like other amphitropical disjuncts (Raven, 1963), weedy attributes of *I. dumetorum* (e.g., annual, herbaceous, hermaphroditic, self-compatible, preferring disturbed habitats, etc.) increased the chance for successful establishment after a dispersal event, either long or short range, occurs.

Ipomoea dumetorum presumably originated in North America (McDonald, 1982), since its relationships are with the wholly North American sect. *Exogonium* (Choisy) Griseb. (Austin, 1977). Preference for high montane habits, otherwise rare in *Ipomoea*, apparently predisposed the successful introduction of *I. dumetorum* into the South American cordilleras, where the species has since undergone considerable range extension.—Andrew McDonald, Dept. of Botany, University of Wisconsin, Madison, WI 53703, U.S.A.

REFERENCES

- AUSTIN, D. 1977 [1978]. Realignment of the species placed in *Exogonium* (Convolvulaceae). Ann. Missouri Bot. Gard. 65:330–339.
- HOUSE, G. 1908. The North American species of the genus *Ipomoea*. Ann. New York Acad. Sci. 18:181–264.
- MCDONALD, A. 1982. Biosystematics of the *Ipomoea tricolor* complex (Convolvulaceae). Ph.D. Dissertation, University of Texas, Austin.
- MOORE, M. 1972. Connections between cool temperature floras, with particular reference to southern South America. In: D. Valentine (ed.), Taxonomy, Phyto-geography, and Evolution. Academic Press, London.
- O'DONELL, C. 1941. Convolvulaceae Mexicanae: I. Notas sobre algunas Convolvulaceas Austro-Mexicans. Anales Inst. Biol. Univ. Nac. México 12:81–113.
- RAVEN, P. 1963. Amphitropical relations in the flora of North and South America. Quart. Rev. Biol. 29:151–177.
- SOLBRIG, O. 1972 [1973]. The floristic disjunctions between the "Monte" in Argentina and the Sonoran desert" in Mexico and the United States. Ann. Missouri Bot. Gard. 59:218–223.

CLEISTOGAMY IN *MUHLENBERGIA CUSPIDATA* (POACEAE)¹—

In preparing the treatment of the genus *Muhlenbergia* for the vascular flora of the southeastern United States a specimen of *Muhlenbergia cuspidata* (Torr.) Rydb. was observed that possessed cleistogamous spikelets enclosed in the basal leaf sheaths. The specimen was collected in Arkansas: Benton County; Ozark Plateau, foothills of the Boston Mountains, gently rolling wooded hills, along Spavinaw River, 1–10 mi E of Oklahoma border, 1000–1250 ft elev., 7 Oct 1928, *Demaree 5540* (UARK). No mention of this occurrence had been previously reported in the literature or descriptions within regional floras (Chase, 1908, 1918, 1951; Connor, 1979; Correll & Johnston, 1970; Lord, 1981; Reeder, 1975).

The cleistogamous inflorescences are rather cryptic within the lower sheaths. The flowering culm from the main culm is approximately 7 cm long and bears 3 small inflorescences. Each inflorescence is approximately 1–2 cm long and enclosed within a spatheolate leaf sheath 1.2–2.3 cm long.

¹ This is a Technical Bulletin TA No. 19031, Texas Agriculture Experiment Station. We would like to thank the curators of the above mentioned herbaria for the use of specimens for the duration of this and other studies.

The ligule is a minute fringe of hairs and the leaf blade is tightly involute, 0.8–4.5 cm long. Spikelet length is approximately the same as that of the chasmogamous spikelets and the base of the spikelets are bulbous rather than linear owing to the ovate shape of the caryopsis. Disarticulation is above the glumes, glumes are ca 1/2 the length of the spikelet. The palea is split between the two nerves as a result of the enlarged caryopsis. The caryopsis is ovate to elliptic, 1.0–1.4 mm long with the surface convoluted, the embryo 1/2–2/3 the length of the caryopsis. Chasmogamous spikelets are typically linear with a caryopsis ca 2 mm long and narrowly elliptic to linear, the surface is smooth, and the embryo 1/2 the length of the caryopsis.

Other specimens of this taxon have been studied to see the extent to which this occurs. However, none of the specimens from CM, DUKE, TAES, TENN, UNC, US, or VPI had inflorescences as that described above. *Clifford W. Morden and Stephan L. Hatch, S. M. Tracy Herbarium, Department of Range Science, Texas A&M University, TX 77843, U.S.A.*

REFERENCES

- CHASE, A. 1908. Notes on cleistogamy of grasses. *Bot. Gaz.* (Crawfordsville) 45:135–136.
- . 1918. Axillary cleistogenes in some American grasses. *Amer. J. Bot.* 5:254–258.
- . 1951. Hitchcock's manual of the grasses of the United States. 2nd ed. USDA Misc. publ. no. 200.
- CONNOR, H. E. 1979. Breeding systems in the grasses: a survey. *New Zealand J. Bot.* 17:547–574.
- CORRELL, D. S. and M. C. JOHNSTON. 1970. Manual of the vascular plants of Texas. Texas Research Foundation, Renner, Texas.
- LORD, E. M. 1981. Cleistogamy: a tool for the study of floral morphogenesis, function and evolution. *Bot. Review* (Lancaster) 47(4):421–449.
- REEDER, C. G. 1975. *Muhlenbergia*. In the grasses of Texas, by F. W. Gould. Texas A&M University Press, College Station, Texas.

CARYA PALLIDA (ASHE) ENGL. & GRAEBN. (JUGLANDACEAE), A NEW ARKANSAS RECORD—While performing a vegetation study of the L'Anguille River basin in Poinsett County, Arkansas, I collected specimens of *Carya pallida*, the pale or sand hickory. A single mature tree was growing on one of the very few islands of ridge bottoms within an extensive belt of hardwood bottoms and swamp forest. Reproduction was not evident, although a cursory search of the immediate area was made at the time. Major associated species were *Quercus pagoda* = (*Q. falcata* var. *pagodifolia*), *Q. nigra* and *Carya tomentosa*. My identification was later verified by Drs. Donald E. Stone, Duke University, and Robert H. Mohlenbrock, Southern Illinois University. The distribution range of *Carya pallida* is mainly confined to the Coastal Plain from New Jersey south to northern Florida and west to Louisiana and inland to Kentucky, southern Illinois, and southwestern Indiana (Little 1977). Although this species had been reported for Critten-

den County, Arkansas from a misidentification (Smith 1978), this *exsiccata* documents a new state record for Arkansas.

Voucher specimens ARKANSAS: Poinset Co.: southern floodplain woods on ridge bottoms, adjacent to L'Anguille River, 21 May 1981, T. E. Heineke 2423 (Memphis District Corps of Engineers, SIU).

—T. E. Heineke, *Environmental Resources Branch, Memphis District Corps of Engineers, Memphis, TN 38103, U.S.A.*

REFERENCES

- LITTLE, E. L. 1977. Atlas of United States trees, volume 4, minor eastern hardwoods. USDA Misc. Publ. 1342, Washington, D.C. 17 pp. (230 maps).
 SMITH, E. B. 1978. An atlas and annotated list of the vascular plants of Arkansas. Student Union Bookstore, University of Arkansas, Fayetteville. 592 pp. +i-iv.

STYLISMA PICKERINGII VAR. *PATTERSONII* (FERN. & SCHUB.) MYINT (CONVOLVULACEAE) REDISCOVERED IN IOWA—In his revision of *Stylisma* Raf. (Convolvulaceae), Myint (1966) divided *Stylisma pickeringii* (Torr. ex M. A. Curtis) A. Gray into two varieties: var. *pickeringii*, with long (2.0–3.0 mm) stylar branches and obtuse sepals; and var. *pattersonii* (Fern. & Schub.) Myint, with short (1.0–1.5 mm) stylar branches and acute sepals. The morphological differences were well correlated with geographical distributions. The typical variety occurs on the Coastal Plain from New Jersey to Alabama. *Stylisma pickeringii* var. *pattersonii* occurs in the southern Great Plains from Texas to Kansas, with disjunct populations on dry sand prairies in southeastern Iowa and adjacent Illinois. These disjunct populations are probably relics of a more extensive Midwestern distribution during the post-Wisconsinian hypsithermal period (Smith 1957).

In Illinois, *Stylisma pickeringii* var. *pattersonii* has been collected only in Henderson (the type locality), Cass, and Mason Counties (Mohlenbrock 1975). In Iowa, it is known only from two specimens collected in Muscatine County in the 1890's: Fruitland Station, in sandy soil along the C. R. I. & P. R. R., 20 Aug 1892, F. Reppert s.n., IA; Muscatine, 10 Sep 1898, L. H. Pammel & F. Reppert s.n. [Iowa Agricultural College Distribution 1221], ISC, MO. Both specimens possibly represent a single population, as Muscatine is the nearest town to Fruitland Station (now simply Fruitland). This taxon was presumed extirpated in Iowa by Roosa and Eilers (1978) due to the lack of more recent collections.

The rather specific locality data on the Reppert specimen invited a search for the plant. I visited Fruitland in July 1983 and noted the presence of a relatively undisturbed tract of dry sand prairie along the railroad tracks on the north edge of town. A search of this prairie tract resulted in the

discovery of six vigorous clumps of *Stylisma pickeringii* var. *pattersonii* and the first collection of this taxon from Iowa in 85 years.

IOWA. Muscatine Co.: Fruitland Twp. T76N R2W S30 NE $\frac{1}{4}$, scattered in dry sand prairie along railroad tracks north of County Road G38, north edge of Fruitland, 7 Jul 1983, T. G. Lammers 5171, F, GH, ILL, ISC, ISTC, MO, NY, OS, OSH, SMU, TEX, US.

—Thomas G. Lammers, Department of Botany, The Ohio State University, Columbus, OH 43210, U.S.A.

REFERENCES

- MOHLENBROCK, R. H. 1975. Guide to the vascular flora of Illinois. Southern Illinois University Press, Carbondale.
 MYINT, T. 1966. Revision of the genus *Stylisma* (Convolvulaceae). *Brittonia* 18:97–117.
 ROOSA, D. M., and L. J. EILERS. 1978. Endangered and threatened Iowa vascular plants. State Preserves Advisory Board, Des Moines.
 SMITH, P. W. 1957. An analysis of post-Wisconsin biogeography of the Prairie Peninsula region based on distributional phenomena among terrestrial vertebrate populations. *Ecology* 38:205–218.

BROMUS STERILIS L. (POACEAE) NEW TO TEXAS.¹—Recent collections from southwest Texas have revealed the occurrence of "barren brome," a grass which was previously unreported from the state. *Bromus sterilis* has been reported throughout much of the eastern United States as far west as Arkansas and in the West from British Columbia south to California and New Mexico (Chase 1951, Martin and Hutchins 1980). Correll and Johnston (1970) and Gould (1975) do not include the species in their manuals of Texas plants. Specimens of *Bromus sterilis* from Texas are not present in the herbaria at Texas A&M University (TAES), University of Texas (TEX-LL), Southern Methodist University (SMU), or Sul Ross State University (SRSC).

The population was discovered in Texas, Kerr Co.: 1 mi E of Hunt, along Hwy 39, 10 Apr 1983, Warren 45 (TAES). The population extends for approximately 5 miles to the east and south of Hunt along State Highway 39 and for approximately 6 miles west along Ranch Road 1340. Both highways follow the forks of the Guadalupe River. The species was noted as occurring along the roadside in moist, semi-shaded areas.

This discovery is significant because it is the first reported collection of the species from Texas. The abundance of plants and extent of the distribution indicate the species has probably been present for at least several years. Whether this is a recent introduction or an isolated occurrence is not known but seemingly similar habitat at all extremes of the distribution may pro-

¹ This is a Technical Bulletin No. T.A. 18973, Texas Agricultural Experiment Station.

vide a potential for expansion of the population in the future.—*Steven D. Warren and Stephan L. Hatch, Department of Range Science, Texas A&M University, College Station, TX 77843, U.S.A.*

REFERENCES

- CHASE, A. 1951. Revision of A. S. Hitchcock's manual of the grasses of the United States, 2nd ed. USDA Misc. Pub. 200. 1051 pp.
 CORRELL, D. S. & M. C. JOHNSTON. 1970. Manual of the vascular plants of Texas. Texas Research Foundation, Renner, TX. 1881 pp.
 GOULD, F. W. 1975. The grasses of Texas. Texas A&M University Press, College Station, TX. 653 pp.
 MARTIN, W. C. & C. R. HUTCHINS. 1980. A flora of New Mexico. Strauss & Cramer, GmbH, Germany. 1276 pp.

CYPERUS OVULARIS (MICHX.) TORR. VAR. *CYLINDRICUS* (ELL.) TORR. (CYPERACEAE) NEW TO NEW MEXICO.—*Cyperus ovularis* var. *cylindricus* (*C. retrorsus* Chapm.), occurs in a wide variety of habitats, ranging from wet marshy shores, wet sand along the edge of lakes and rivers, roadside ditches, and other wet areas to pine savannas, well-drained sands and clays, and roadside clearings. It has been previously reported mainly along the coastal plain from New York south to Florida, west to central Texas, and less frequently inland to eastern Kansas and Oklahoma (Correll and Correll, 1975; Godfrey and Wooten, 1979). This species was not listed in the flora of New Mexico by Martin and Hutchins (1980).

Collection data: NEW MEXICO. Donna Ana Co.: Mesilla Valley near Las Cruces, 1 Sep 1983, *Allred s.n.* (TAES).

—*James W. Kessler, S. M. Tracy Herbarium, Dept. of Range Science, Texas A&M University, College Station, TX 77843, U.S.A.*

REFERENCE

- CORRELL, D. S. and H. B. CORRELL. 1975. Aquatic and wetland plants of southwestern United States. Vol. I. Sanford University Press, Stanford.
 GODFREY, R. K. and J. W. WOOTEN. 1979. Aquatic and wetland plants of southeastern United States. Monocotyledons. The University of Georgia Press, Athens.
 MARTIN, W. C. and C. R. HUTCHINS. 1980. A flora of New Mexico. Vol. I. J. Cramer, Hirschberg, Germany.

ARNOGLOSSUM SULCATUM (ASTERACEAE) IN MISSISSIPPI.—*Arnoglossum sulcatum* (Fernald) H. Robinson is reported here as new to the flora of Mississippi. The southeastern state locality marks the new western edge of its range previously reported in wet pine flatwoods, bogs, stream banks, and low places from the Florida panhandle, southwestern Georgia, and southern Alabama (Cronquist, 1980; Kral and Godfrey, 1958). The specimen for this record, determined as *Cacalia lanceolata*, was part of a student's plant collection donated to the Mississippi Museum of Natural Sci-

ence herbarium. The misidentification was noted and corrected during routine herbarium work.

MISSISSIPPI. Jackson Co.: at Vancleave along highway in wetlands, *Barry Snow s.n.*, May 1975 (MMNS).

A variety of wetland vegetation types, typical of the Coastal Pine Meadows in southeastern Mississippi, occur in the vicinity of this collection. I recently made a brief field survey through several of these bogs, bayheads, titi flats, and a disjunct Atlantic White Cedar stand along Bluff Creek, but did not relocate the species.—*Will W. McDearman, Mississippi Museum of Natural Science, Jackson, MS 39202, U.S.A.*

REFERENCES

- CRONQUIST, A. 1980. Vascular flora of the southeastern United States. Vol. I. University of North Carolina Press, Chapel Hill, North Carolina, 261 pp. + xvi.
KRAL, R. and R. K. GODFREY. 1958 [1959]. Synopsis of the Florida species of *Cacalia* (Compositae). *Quart. J. Florida Acad. Sci.* 21(3):193–206.

NEW GRASS (POACEAE) DISTRIBUTION RECORDS FOR MEXICO¹—While collecting and working through collections of grasses (Poaceae) from Mexico, we encountered twelve taxa with distributions new to the states of CHIAPAS, CHIHUAHUA, COAHUILA, NEUVO LEON, OAXACA, TAMAULIPAS AND ZACATECAS, two of which are new records to Mexico. All these records are extensions to the known distributions of these species as recorded in general for Mexico by Beetle (1977), Hitchcock (1913, 1951), Johnston (1943), Swallen (1955), Valdes et al. (1975), and Valdes (1977). Voucher specimens for these records are deposited in one or more of the following herbaria: ANSM, CHAPA, ENCB, MEXU, MO, TAES, TEX, and US (Holmgren et al. 1981). These reported collections increase the knowledge of the floristics of these areas, and in general add to the knowledge of the grass flora of Mexico.

GLYCERIA STRIATA (Lam.) Hitchc., (Pooideae: Meliceae), COAHUILA: Serranias del Burro, Rancho El Bonito, 12 km N of headquarters, Municipio de Ciudad Acuna, locally common along a small damp ditch, 29° 01' 30" N lat., 102° 07' 30" W long., elev 1625 m, 18 Sep 1977, *Valdes R. & Risking VR-1231* (ANSM, TAES, TEX). In Mexico, this taxon is known to occur in Chiapas, Chihuahua, Hidalgo, Mexico, and Puebla.

STIPA ICHU (Ruiz & Pavon) Kunth, (Pooideae: Stipeae), CHIAPAS: *Gould & Hatch 14418* (TAES); *Gould 11681* (ENCB, TAES); *Gould 12698* (ENCB, TAES); *Breedlove 7817* (ENCB, TAES); *Breedlove 10467, 12346, 23028, 24355* (TAES); *Raven & Breedlove 8084, 20142* (ENCB,

¹ This is a Technical Bulletin No. T. A. 19086, Texas Agricultural Experiment Station.

TAES); *Reeder & Reeder* 2118, 6069 (ENCB); *Shilom Ton* 435 (ENCB); *Smith & Breedlove* 31809 (ENCB, TAES); *Laughlin* 576 (ENCB); *Laughlin* 2240 (ENCB, TAES). This species occurs in Mexico on dry hills and plains of Coahuila, Hidalgo, Mexico, Morelos, Oaxaca, Puebla, Queretaro, San Luis Potosi, Tlaxcala, and Veracruz, and in Guatemala, Costa Rica and Argentina.

STIPA LOBATA Swallen, (Pooideae: Stipeae), CHIHUAHUA: ca 31 (air) mi NW of Julimes in a SW facing canyon above rancho El Recuerdo in Sierra de Carrasco; infrequent perennial, $28^{\circ} 41' N$ lat., $105^{\circ} 09' W$ long; elev 5800 ft, 15 Sep 1973. *Henrickson* 12960 (TEX). NUEVO LEON: Sierra Madre Oriental, foothills below Pablillo, 15 mi SW of Galeana; common in oak scrub, elev 7500–8000 ft, 21 May 1934, *Mueller & Mueller* 878 (TEX). TAMAULIPAS: 16 km SE of Bustamante toward La Presita and Tula; by winding road, common, $23^{\circ} 21' N$ lat., $99^{\circ} 40' W$ long., elev 1700 m, 26 May 1982, *Valdes R. & Carranza* VR-1474, VR-1475 (ANSM, TAES, TEX). ZACATECAS: 4 km E of Salaverna on the hwy to Concepcion de Oro; pinyon woods, steep limestone slopes, $24^{\circ} 37' N$ lat., $101^{\circ} 28' W$ long; elev 2800 m, 1 Jul 1973, *Johnston, Wendt & Chang* 11549 (TEX). *Stipa lobata* is endemic to the Chihuahuan Desert Region of the United States and Mexico, it was previously known in Mexico from Coahuila (Beetle, 1977).

STIPA NEOMEXICANA (Thurb.) Scribn., (Pooideae: Stipeae), CHIHUAHUA: Sierra San Martin de Borracho, approached from the abandoned rancho Carrizozo on the north side; steep limestone slopes, mostly north facing, $30^{\circ} 47' 30'' N$ lat., $105^{\circ} 35' 30'' W$ long; elev 1500–2195 m, 15 Jun 1973, *Johnston, Wendt & Chiang* 11341 (TEX). TAMAULIPAS: 16 km SE of Bustamante toward La Presita and Tula; by winding road, common, $23^{\circ} 21' N$ lat., $99^{\circ} 40' W$ long., elev 1700 m, 26 May 1982, *Valdes R. & Carranza* VR-1471 (ANSM, TAES, TEX). This species occurs on rocky slopes and was known to occur in the arid western United States as well as Coahuila, Nuevo Leon and San Luis Potosi in Mexico.

VULPIA MYUROS (L.) K.C. Gmelin var. *HIRSUTA* Hack, (Pooideae: Poeae), CHIAPAS: *Gould & Hatch* 14414 (TAES); *Gould* 12754 (MO, TAES); *Breedlove* 40278 (MEXU). This is a new report for the species as well as the variety in Chiapas. *Vulpia myuros* is widespread in North America from Alaska and British Columbia to Mexico, where is known to occur from Hidalgo, Mexico, Michoacan, Morelos, Oaxaca, Puebla, and San Luis Potosi.

METCALFIA MEXICANA (Scribn.) Conert, (Pooideae: Aveneae), TAMAULIPAS: 16 km SE of Bustamante toward La Presita and Tula; by winding road, common, $23^{\circ} 21' N$ lat., $99^{\circ} 40' W$ long., elev 1700 m, 26 May 1982, *Valdes R. & Carranza* VR-1482, 1491, 1494 (ANSM, TAES, TEX). This

species, endemic to Mexico was known to occur from Chiapas, Coahuila, Nuevo Leon, Puebla, and San Luis Potosi.

SPOROBOLUS ASPER (Michx.) Kunth, (Chloridoideae: Eragrosteae), COAHUILA: La Boquilla, Rancho La Encantada, Municipio de Muzquiz, 30 Jun 1966, *Santos L. s.n.* (ANSM). This is a new record for Mexico. This species is in the checklist of grasses of Coahuila (Valdes, 1977); however, no localities nor herbarium citations for the specimens were given; therefore, we have included it here. This species occurs frequently in grasslands of the United States from Vermont to eastern Washington, south to Mississippi, Louisiana, Texas and Arizona (Gould, 1975).

SPOROBOLUS SPICIFORMIS Swallen, (Chloridoideae: Eragrosteae), CHIHUAHUA: ca 27 (air) mi near Carrillo, N end of Laguna del las Palomas; infrequent, 26° 52' N lat., 103° 55' W long., elev 1100 m, 17 Sep 1974, *Henrickson 14136* (TEX). NUEVO LEON: 33 mi SE of jct. of Monterrey Monclova road with Mex Hwy 57; rather extensive gypsum flat, abundant, elev 2400 ft, 11 Sep 1963, *Reeder & Reeder 5190* (ENCB). This is another mexican endemic from the Chihuahuan Desert Region, and previously known only from the type locality in Coahuila.

PEREILEMA CRINITUM Presl, (Chloridoideae: Eragrosteae), OAXACA: *Gould & Hatch 14359* (TAES); *Pringle 6016* (MEXU, MO); *Kaplan & Kaplan 96* (MEXU); *Tellez 3881* (MEXU). This grass occurs from Mexico and Central America south to Columbia and Ecuador. In Mexico it has been reported from Aguascalientes, Baja California Sur, Chiapas, Durango, Guerrero, Jalisco, Mexico, Michoacan, Morelos, Sinaloa, and Veracruz.

PAPPOPHORUM VAGINATUM Buckl., (Chloridoideae: Pappophoreae), CHIHUAHUA: 14 km N of Delicias on a road from Chihuahua to Delicias; common, perennial, bunchgrass on road side, 29 Jun 1974, *Koch 74156* (CHAPA, TEX). It has been reported in Mexico from Coahuila, Durango, Nuevo Leon, San Luis Potosi, Sonora, Tamaulipas, and Zacatecas.

BOTHRIOCHLOA EDWARDSIANA (Gould) L. R. Parodi, (Panicoideae: Andropogoneae), OAXACA: 275 km NW of Oaxaca; among shrubs on open ridge, 19 Oct 1973, *Gould & Hatch 14366* (TAES). This is a new record for Mexico. This species occurs in the United States where known only from Edwards, Kerr and Menard counties in Texas; it is also known from Argentina and Uruguay (Gould, 1975).

SCHIZACHYRIUM SANGUINEUM (Retz.) Alst. var. *OLIGOSTACHYUM* (Chapm.) Hatch, (Panicoideae: Andropogoneae), CHIHUAHUA: *Correll & Gentry 22987* (TEX, US); *Palmer 7* (US); *Townsend & Barber 335* (US). The species ranges from Florida, the Caribbean, and south from Mexico to Brazil. In Mexico it occurs in Chiapas, Durango, Guerrero, Hidalgo, Jalisco, Michoacan, Morelos, Oaxaca, Queretaro, Sinaloa, and Sonora (Hatch, 1975).

—Jesus Valdes R.² and Stephan L. Hatch, Department of Range Science, Texas A&M University, College Station, Texas 77843, U.S.A.

REFERENCES

- BEETLE, A. A. 1977. Noteworthy grasses from Mexico V. *Phytologia* 37:317–407.
- GOULD, F. W. 1975. The grasses of Texas. Texas A&M Univ. Press. College Station, Texas. 653 pp.
- HATCH, S. L. 1975. A biosystematic study of the *Schizachyrium cirratum*-*Schizachyrium sanguineum* complex (Poaceae). Ph.D. Dissertation. Texas A&M Univ., College Station, Texas. 112 pp.
- HITCHCOCK, A. S. 1913. Mexican grasses in the U.S. National Herbarium. *Contr. U.S. Natl. Herb.* 17:181–389.
- . 1951. Manual of the grasses of the United States. U.S.D.A. Misc. Publ. 200. 1051 pp. 2d. Ed. Rev. by A. Chase.
- HOLMGREN, P. K., W. KEUKEN, and E. K. SCHOFIELD. 1981. Index Herbariorum. Part I. The herbaria of the world. 7th Ed. *Regnum Vegetabile*. Vol 106. Utrecht, The Netherlands.
- JOHNSTON, I. M. 1943. Plants of Coahuila, eastern Chihuahua, and adjoining Zacatecas and Durango, II. *J. Arnold Arbor.* 24:375–421.
- SWALLEN, J. R. 1955. Flora of Guatemala II. Grasses of Guatemala. *Fieldiana Botany* 24:1–390.
- VALDES R., J. 1977. Gramineas de Coahuila. *Monografia Tecnico Cientifica* 3:884–1018. Univ. Aut. Agr. Antonio Narro, Saltillo Mexico.
- , A. A. BEETLE y M. H. GONZALEZ. 1975. Gramineas de Chihuahua. *Bol. Pastizales* VI: 60 pp. Rancho Exp. La Campana INIP-SAG Mexico.

ECHINODORUS TENELLUS VAR. *PARVULUS* (ALISMATACEAE)
IN KENTUCKY—The distribution of *Enchinodorus tenellus* (Mart.) Buch. var. *parvulus* (Engel.) Fassett = *E. parvulus* Engel. (Alismataceae) was shown by Fassett (1955) to be mostly coastal and to extend intermittently from Massachusetts south to Florida, Cuba, and westward to Texas and eastern Mexico. Inland stations were shown from the St. Louis area of Missouri and Illinois and from southern Missouri. Subsequent coastal records were found in South Carolina (Leonard, 1972), Louisiana (Curry & Allen, 1973), and Alabama (Haynes, 1980). Other inland stations were reported from Arkansas (Lipscomb, 1977) and Illinois (Mohlenbrock, 1970). Rogers (1983) noted that the range also includes Kansas and Michigan.

During the summer of 1983 an extensive population of this mat-forming annual was found on the Pennyroyal Plain, Interior Low Plateaus, in southwestern Kentucky. The habitat was a temporarily ponded, shallow depression covering about 1.5 ha on a level, cultivated upland. Plants were mostly in silty mud near the receding water line where large mats covering several square meters were common. An associated species of interest was *Heteranthera limosa* (Sw.) Willd., an endangered species in Kentucky (Branson et al., 1981), which grew on open mud between *Echinodorus* mats.

² Author acknowledges CONACYT, Mexico, grant 8817, for financial support.

This Kentucky collection provides another location outside of the Coastal Plain, the primary area of distribution, and is the first report from the Interior Low Plateaus. While perhaps a recent introduction, the population size suggests an extensive seed source from previous growth in the same area even though the depression is dry enough for cultivation in some years.

Voucher specimens of *Chester* 83-287 (Kentucky. Christian Co.: 18 Aug 1983) have been deposited in APSU, KNK, SMU, and VDB.—*Edward W. Chester and Kevin Souza, Dept. of Biology, Austin Peay State University, Clarksville, TN 37040, U.S.A.*

REFERENCES

- BRANSON, B. A., D. F. HARKER, J. M. BASKIN, M. E. MEDLEY, D. L. BATCH, M. L. WARREN, W. H. DAVIS, W. C. HOUTCOOPER, B. MONROE, L. R. PHILLIPPE, and P. CUPP. 1981. Endangered, threatened, and rare animals and plants of Kentucky. *Trans. Kentucky. Acad. Sci.* 42:77–89.
- CURREY, M. G., and C. M. ALLEN. 1973. Alismataceae of Louisiana: taxonomy, distribution, and field key. *Proc. Louisiana Acad. Sci.* 36:88–95.
- FASSETT, N. C. 1955. *Echinodorus* in the American tropics. *Rhodora* 57:133–156, 174–188, 202–212.
- HAYNES, R. R. 1980. Aquatic and marsh plants of Alabama. I. Alismatidae. *Castanea* 45:31–50.
- LEONARD, S. W. 1972. New records and notes on the flora of the Carolinas. *J. Elisha Mitchell Sci. Soc.* 88: 265–266.
- LIPSCOMB, B. 1977. *Echinodorus tenellus* var. *parvulus* (Alismataceae) in the Ozarks of Arkansas. *Castanea* 42:254–255.
- MOHLENBROCK, R. H. 1970. The illustrated flora of Illinois, flowering rush to rushes. Southern Illinois University Press, Carbondale. 272 p.
- ROGERS, G. K. 1983. The genera of Alismataceae in the southeastern United States. *J. Arnold Arbor.* 64:383–420.

CAREX ROSEA (CYPERACEAE), *TRIFOLIUM LAPPACEUM* (FABACEAE) AND *AIRA CARYOPHYLLEA* (POACEAE) NEW TO TEXAS—*CAREX ROSEA* Schkuhr is a woodland sedge ranging from Canada south to Louisiana and Oklahoma (Fernald, 1950; Waterfall, 1966). A collection of this species (*Brown* 4805 SMU) in April of 1980 is apparently the first reported for the state. The specimen was collected on a moist wooded seepage slope within Eisenhower Park in northeast Harris Co. near San Jacinto River south of the dam at Lake Houston.

TRIFOLIUM LAPPACEUM L., an introduced clover, was collected in May of 1979 in Harris Co. from a yard adjacent to Kirby Drive in Taylor Lake Village (*Brown* 4370; SMU, TEX) and in Hardin Co. from the roadside of U. S. Hwy. 69 ca 4 miles north of the intersection with Hwy. 420 (*Brown* 4475 SMU).

AIRA CARYOPHYLLEA L. was found in 1981 on sandy soil within the Little Thicket Nature Sanctuary ca 2 miles south of Evergreen on Hwy. 945 in San Jacinto Co. (*Brown and Peterson* 5307 SMU, TAES). This site is ca

170 miles west of the nearest recorded locality in Evangeline Parish, Louisiana (Allen, 1981).—*Larry E. Brown, Department of Biology, Houston Community College, Houston, TX 77007, U.S.A.; Charles D. Peterson, R.A. Vines Science Center, Houston, TX 77055, U.S.A.*

REFERENCES

- ALLEN, C. M. 1981. Grasses of Louisiana. The University of Southwestern Louisiana, Lafayette.
- CORRELL, D. S. & M. C. JOHNSTON. 1970. Manual of the vascular plants of Texas. Texas Research Foundation, Renner.
- FERNALD, M. L. 1940. Gray's manual, 8th ed. Amer. Book Co., N. Y.
- HERMAN, F. J. 1953. A botanical synopsis of the cultivated clovers (*Trifolium*). U. S. Dep. Agric. Monogr. 22.
- WATERFALL, U. T. 1966. Keys to the flora of Oklahoma, 3rd ed. Student Union Book Store. Oklahoma State University, Stillwater.

IN MEMORIAM

RICHARD HARLEY DAVIS, 1946—1983

The Arkansas botanical community lost a dedicated friend and contributor with the death of Richard Harley Davis on December 8, 1983. His professional life as a botanist was short-lived but was marked by a lasting contribution to a better understanding of plant distributions in the state.

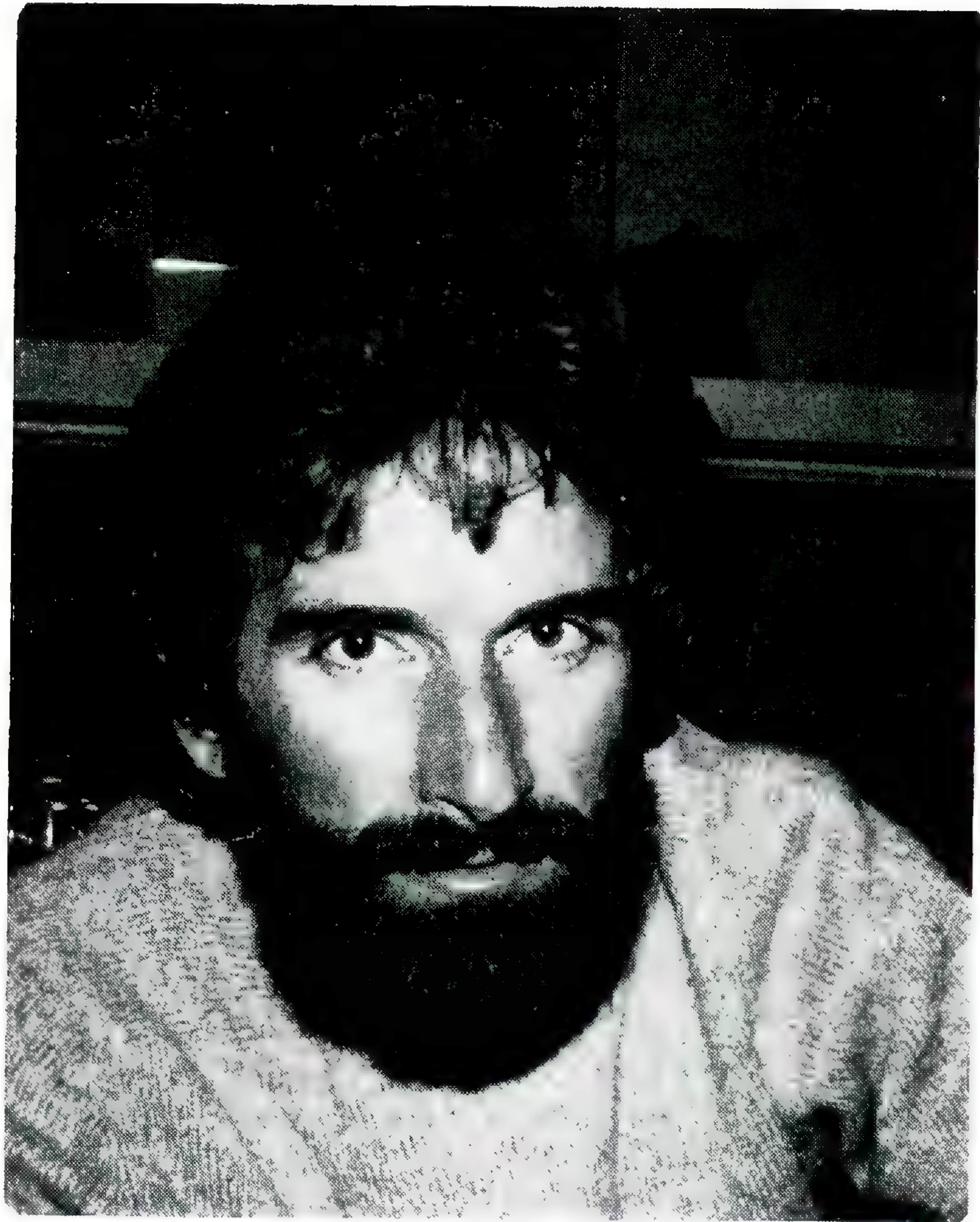
Richard Davis was born in Kingsville, Texas, on January 10, 1946, the son of Max and Ruth Davis. His immediate survivors include only his father and his sister, Kay Davis.

Graduating from high school in 1964 at El Dorado, Arkansas, where he spent most of his childhood, Richard enrolled as a biology major at Arkansas Tech University. He left Tech in 1966 and spent two years with the marines in Viet Nam. After service he returned to Tech and graduated with a B.S. in Biology in 1972. Following graduation he taught high school science courses at Altus and Atkins, Arkansas.

Richard spent the year of 1975 as a graduate student in the Department of Botany and Bacteriology, University of Arkansas, Fayetteville. The following year he took a job with the Arkansas Natural Heritage Commission as a field ecologist, employment that involved field work and introduced him to natural areas preservation, a field that soon had his commitment (his final request was that any memorials be sent to The Nature Conservancy, 300 Spring Building, Suite 415, Little Rock, AR 72201). He returned to the University in 1977 and completed his M.S. in Botany in 1978. His thesis, completed under Dr. E. E. Dale, was "Criteria for the Selection of National Natural Landmarks in the Interior Highlands Physiographic Region, Central U. S."

During 1979-81 Richard was employed by The Nature Conservancy, where he developed a working list of rare plants of Arkansas and made extensive plant collections. The bulk of his collections have been deposited at Arkansas Tech University (APCR). Additional specimens are deposited at the University of Arkansas (UARK) and smaller numbers at Vanderbilt University (VDB).

Richard was an untiring worker in the field and had matured to a high level of competency as a field botanist. Going to the field with him was an experience. Almost always dressed in short pants, often without a shirt, and often in sandals, he could penetrate any vegetation type. Nothing was too difficult or too much trouble if it meant getting to see a plant that was new to him. My last field experience with Richard was a three-day trip to Stone County, Arkansas, in August 1982. He confided to me at that time that he had a diagnosis of terminal cancer. Wanting to see the West one more



RICHARD HARLEY DAVIS, 1946–1983

time he left Arkansas, returning to Arkansas almost exactly one year later, in 1983, with the realization that the worst had come true. He had come home to die.

He was a man of extremely simple life style and surrounded himself with few possessions. At the same time Richard was a complex person. Periodically he would feel the urge to travel, and over the years he made many trips to Mexico, Central America, and all parts of the U. S. Much of his travel was by bicycle. It was on these trips that he often took work as a gardener, painter, boat-builder—any job with which he could make a little extra money that would enable him to “see the country and new plants.” He enjoyed physical labor and always was in the best of physical condition—up until the very last.

In many respects Richard was a person born too late. He was intrigued with the era of professional plant collectors and what appeared to him to have been a much simpler life style. He was a product of the 1960's; his stint with the military in Viet Nam had a devastating effect on him and was to shape much of what he did in later years. Metaphysics held a long-term interest for him, and he read voraciously on the subject, forever searching for the meaning of his existence.

Richard was a gentle person, sensitive to the aesthetic and to the environment, and much loved by those who let themselves get close to him. He held tightly to his principles, sometimes to the point of obstinacy; he was the original idealist, and often his ideals collided forcefully with reality. But that was what made Richard what he was.

Richard Davis left a valuable collection of plant specimens for botanists of the future to pore over in the herbarium. Perhaps this remembrance will help those of the future have a glimmer of understanding of the collector. He had a zeal for field work that made trips to the field with him memorable. —*Gary Tucker, Biological Sciences Dept., Arkansas Tech University, Russellville, AR 72801, U.S.A.*

SIDA CONTRIBUTIONS TO BOTANY

VOLUME 10

NUMBER 4

NOVEMBER 1984

CONTENTS

Chromosome numbers and taxonomic notes in the genus <i>Nama</i> (Hydrophyllaceae). II. <i>John D. Bacon</i> .	269
Biosystematic study and typification of the Californian <i>Coreopsis</i> (Compositae) sections <i>Tuckermannia</i> , <i>Pugiopappus</i> , and <i>Euleptosyne</i> . <i>Edwin B. Smith</i> .	276
On the history of coastal plain species on the Cumberland Plateau and Highland Rim. <i>A. M. Harvill, Jr.</i>	290
Noteworthy plants from north Florida. <i>Loran C. Anderson</i> .	295
Taxonomic notes on two common neotropical species of <i>Cyperus</i> (Cyperaceae). <i>Gordon C. Tucker</i> .	298
Provisional synopsis of the species and natural hybrids in <i>Duranta</i> (Verbenaceae). <i>Roger W. Sanders</i> .	308
Sidus Sidarum—IV. A new record of <i>Sida</i> in North America, <i>S. santaremensis</i> (Malvaceae). <i>Paul A.</i> <i>Fryxell, Antonio Krapovickas, and David Crewz</i> .	319
NOTES. A new combination in the Poaceae. 321—An addition to the New Mexico flora, <i>Glossopetalon planitierum</i> (Crossosmataceae). 321— <i>Scirpus cernuus</i> Vahl var. <i>californicus</i> (Torr.) Beetle (Cyperaceae) new to Texas. 322—Two adventive species of grasses, <i>Apera interrupta</i> and <i>Deschampsia danthonioides</i> (Poaceae), new to the Ohio flora. 322— <i>Solidago flaccidifolia</i> Small (Asteraceae) new to Oklahoma and other goldenrod notes. 324—New additions or otherwise noteworthy plants of Texas. 326.	
CORRECTION	328
REVIEW	328
REVIEWERS	333
INDEX TO VOLUME 10	334

US ISSN 0036-1488

SIDA, CONTRIBUTIONS TO BOTANY

Founded by Lloyd H. Shinnars, 1962

Publisher

Wm. F. Mahler
SMU Herbarium
Dallas, Texas, 75275

Associate Editor

John W. Thieret
Northern Kentucky University
Highland Heights, Kentucky, 41076

Editor

Barney L. Lipscomb
SMU Herbarium
Dallas, Texas, 75275

Guidelines for contributors are available upon request.

Subscription: \$10.00 (U.S.) per year; numbers issued twice a year.

©

Sida, Contributions to Botany, Volume 10, Number 4, pages 269–341.

Copyright 1984

by Wm. F. Mahler

CHROMOSOME NUMBERS AND TAXONOMIC NOTES IN THE GENUS *NAMA* (HYDROPHYLLACEAE). II.

JOHN D. BACON

Department of Biology
The University of Texas at Arlington
Arlington, TX 76019, U.S.A.

ABSTRACT

Chromosome numbers are reported for 39 taxa of *Nama*. Counts for 25 taxa confirm numbers as previously reported. Counts for 14 taxa are initial reports; 12 taxa conform to the generally diploid pattern found in the genus, while two, *N. dichotomum* vars. *dichotomum* and *pueblense*, are tetraploid with $n=14$. Notes on relationships of selected taxa are included.

INTRODUCTION

Nama houses a diverse assemblage of about 50 species ranging in habit from delicate annuals to robust, woody perennials. Taxa occupy a diversity of habitats, as well, but a majority are confined to the drier regions of the southwestern United States and Mexico. A few species are wide ranging, almost weedy in nature, but most are restricted in distribution. The restriction of several taxa is edaphic and based on the occurrence of gypsum; indeed, some are so faithful to the substrate that they are known as gypsum indicators (Johnston, 1941; Waterfall, 1946). Others, apparently, are even more restricted, causal factors as yet undetermined, and known only from their types or collections near the type locality.

Chromosome numbers have been reported for 25 species and 9 varieties of *Nama* (Bacon, 1974; Cave and Constance, 1947, 1950, 1959; Constance, 1963). Reports portray the genus as remarkably diploid with a base of $x=7$. Only a single species, *N. rothrockii*, departs from the base and only two, *N. lobbii* and *N. jamaicense*, are known to be consistently tetraploid.

In connection with a revisional study of the genus, field collections of the various species, including bud material for chromosome determinations, have been gathered over the past two and one half years. Contained in this communication are original chromosome number determinations for 39 taxa of *Nama*. Included are first reports for 14 taxa, additional counts, from different geographic regions, for previously reported taxa and taxonomic notes bearing upon the status, placement or relationships of various taxa.

MATERIALS AND METHODS

Bud material was field collected into a modified Carnoy's fluid, chloroform:

95% ethanol: glacial acetic acid (4:3:1 V/V). Material was refrigerated, upon return to the laboratory, until examined. Chromosome numbers were determined from pollen mother cells utilizing the aceto-carmin squash technique (Smith, 1947).

RESULTS AND DISCUSSION

Table 1 presents results for the 88 counts obtained. As can be seen, all taxa are based on $x=7$, except *N. rothrockii*. Counts for previously reported species confirm published numbers. Taxa for which initial counts are reported conform to the strikingly diploid pattern of the genus, with two exceptions; *N. dichotomum* vars. *dichotomum* and *pueblense* are consistently tetraploid. Also, Table 1 contains corrections for two taxa misidentified by Bacon (1974).

Counts for *N. flavescens* are first reports. This taxon is a member of a distinctive group of linear-leaved, perennial species found in the Chihuahuan Desert, the majority of which are obligate gypsophiles. Beguiled by the trend among these species, I have previously implied or stated that *N. flavescens*, too, is an obligate gypsophile (Bacon, 1981). However, collections reported herein, as well as others, were taken from calcareous, gravelly soils or highly fractured limestone beds of roadcuts or mountain slopes. While soils at these localities may harbor some small quantity of gypsum, they certainly are not clearly gypseous as are those in which the obligate gypsophiles, such as *N. stenophyllum* Gray, *N. canescens* and *N. carnosum*, are found. At most, *N. flavescens* appears to be a facultative gypsophile.

The count for *N. pringlei* is the first for this rarely collected species. Hitchcock (1933) reduced this taxon to varietal status under *N. coulteri*. Subsequently, Hitchcock (1939) reassessed his placement and stated that *N. pringlei* could be more consistently recognized as a distinct species. Despite this later re-evaluation, the implication that the two taxa are closely related has persisted. But, it is now clear that they are quite distinct. Indeed, seed features readily separate the two; as examined under the light microscope ($\times 50$) seeds of *N. coulteri* are yellow-orange in color and ovoid-fusiform in shape; those of *N. pringlei* are brown and irregularly oblong. Utilizing ultrastructural features of the seed coat, Chance and Bacon (1984) have identified six species groups within *Nama*. Seeds of *N. coulteri* clearly ally the species with the group to which *N. hispidum* and *N. undulatum*, among others, belong. Seed features of *N. pringlei* are not so readily apparent under the light microscope; however, color, shape and surface patterning suggests it is to be placed within either the group to which *N. dichotomum* belongs or a group in which *N. hirsutum* resides. Seed studies utilizing the scanning electron microscope are underway for these and yet other unexamined species and should resolve the placement of *N. pringlei*. In any event, the relationship between the latter species and *N. coulteri* should be viewed as distant.

TABLE 1. CHROMOSOME NUMBERS IN *NAMA*

(Voucher specimens are or will be deposited at TEX. Counts and collections unless noted otherwise, are those of the author. Numbers between 1716 and 1762 are Bacon and Dillon; those above 1875 are Bacon, Furlow and Barrie.)

-
- N. aretioides* (H. & A.) Brand
 $n=7$ UNITED STATES: CALIFORNIA: Inyo Co.: Gooddale Creek Recreation Area, 1799; 7 mi W of Bishop, 1805; 9 mi W of Bishop, 1806; Mono Co.: ca 42 mi E of Lee Vining on Hwy 120, 1863. NEVADA: Washoe Co.: 12 mi N of Sparks, 1808; 7 mi N of Nixon, 1809.
- N. biflorum* Choisy
 $n=7$ MÉXICO: NUEVO LEÓN: Salto Cola de Caballo, 1826, 1876.
- N. canescens* C. L. Hitchc.
 $n=7$ MÉXICO: NUEVO LEÓN: 2 mi E of San Roberto Jct., 1906; 6.7 mi E of San Roberto Jct., 1489; 16 mi W of Iturbide, 1897. Zacatecas: 26 mi S of Zacatecas—Coahuila boundary, 1913.
- N. carnosum* (Woot.) C. L. Hitchc.
 $n=7$ UNITED STATES: NEW MEXICO: Eddy Co.: 6 mi N of Texas-New Mexico boundary on Hwy 62-280, 1851. TEXAS: Reeves Co.: 2 mi S of Hwy 752, 19 mi W of Orla, 1850.
- N. coulteri* Gray
 $n=7$ MÉXICO: SONORA: 5 mi E of Hornos on Hwy 11, 1843; 25 mi NE of Esperanza, 1844; 13 mi W of Tónichi on Hwy 16, 1848; 63 mi E of Hwy 15 towards Moctezuma, 1849.
- N. demissum* Gray var. *demissum*
 $n=7$ UNITED STATES: NEVADA: Clark Co.: 10 mi E of jct Hwy 40 and IH 15, 1764; vicinity of Mountain Springs, 1795, 1858.
- N. demissum* Gray var. *deserti* Brand*
 $n=7$ UNITED STATES: CALIFORNIA: Inyo Co.: 11 mi S of Big Pine, 1802; 4 mi E of Big Pine, 1803.
- N. densum* Lemm.
 $n=7$ UNITED STATES: CALIFORNIA: Mono Co.: 7 mi W of Benton on Hwy 120, 1807, 1864; 22 mi W of Benton, 1862; 45 mi W of Benton, 1861; near High Altitude Research Station in White Mountains, 1814.
- N. depressum* Lemm ex Gray
 $n=7$ UNITED STATES: CALIFORNIA: Inyo Co.: Gooddale Creek Recreation Area, 1800.
- N. dichotomum* (R. & P.) Choisy var. *chasmogamum* Brand*
 $n=7$ MÉXICO: OAXACA: 4 mi S of Sola de Vega, 2077. Veracruz: 2 mi above Acultzingo on Hwy 150, 2081.
- N. dichotomum* (R. & P.) Choisy var. *dichotomum**
 $n=14$ MÉXICO: MÉXICO: 0.2 mi N of Dongue on Hwy 55, 1833. UNITED STATES: ARIZONA: Coconino Co.: Coconino Natl. Forest, 1702; 13 mi N of Flagstaff on Hwy 89, 1703.
- N. dichotomum* (R. & P.) Choisy var. *pueblense* (Robins. & Greenm.) Macbride*
 $n=14$ MÉXICO: PUEBLA: 38 mi N of Tehuacán on Hwy 150, 2057. OAXACA: ruins at Mitla, 1835, 2079; near Teposcolula, 2065. VERACRUZ: 2 mi above Acultzingo, 2082.
- N. flavescens* Brandeg.*
 $n=7$ MÉXICO: ZACATECAS: 0.4 mi S of Zacatecas-Coahuila boundary on

TABLE 1. CHROMOSOME NUMBERS IN *NAMA* (CONTINUED)

- Hwy 54, 1911; 11 mi E of Cedros, 1914.
- N. hirsutum* Mart. & Gal.*
 $n=7$ MÉXICO: OAXACA: 10 mi NE of jct Hwy 175 and 190, 1836.
- N. hispidum* Gray var. *mentzelii* Brand
 $n=7$ UNITED STATES: NEW MEXICO: Doña Ana Co.: 25 mi W of Las Cruces on IH 10, 1762; 27 mi S of Deming on Hwy 11, 1763.
- N. hispidum* Gray var. *sonorae* C. L. Hitchc.
 $n=7$ MÉXICO: SONORA: 5 mi E of Esperanza on Hwy 11, 1843a; 25 mi NE of Esperanza, 1844a; 8 mi N of Rosario, 1845; 4 mi N of Nuri, 1846.
- N. hitchcockii* Bacon
 $n=7$ MÉXICO: NUEVO LEÓN: 2 mi N of Hwy 58 on road to Galeana, 1827 (and as *N. johnstonii* C. L. Hitchc. in Bacon, 1974).
- N. jamaicense* L.
 $n=14$ MÉXICO: SONORA: 5 mi E of Esperanza on Hwy 11, 1842a. VERA-CRUZ: 7 mi N of Orizaba, 1755.
- N. lobbii* Gray
 $n=14$ UNITED STATES: CALIFORNIA: Siskiyou Co.: 17 mi S of McCloud, 1818.
- N. organifolium* H.B.K. var. *organifolium**
 $n=7$ MÉXICO: DURANGO: 16 mi W of Durango on Hwy 40, 1840. HIDALGO: 7 mi NE of Ixmiquilpan, 1716.
- N. palmeri* Gray ex Hemsl. var. *palmeri*
 $n=7$ MÉXICO: NUEVO LEÓN: 22 mi W of Linares on Hwy 58, 1891; 1.5 mi N of Pablillo on Hwy 58, 1828. SAN LUIS POTOSI: 3 mi E of Hwy 57 on road to Guadalcázar, 1830.
- N. parviflorum* (Greenm.) Const.
 $n=7$ UNITED STATES: NEVADA: Washoe Co.: 7 mi N of Nixon, 1810. OREGON: Lake Co.: 64 mi NE of Lakeview on Hwy 395, 1865.
- N. parvifolium* (Torr.) Greenm.*
 $n=7$ MÉXICO: TAMAULIPAS: 34 mi N of Soto la Marina on Hwy 180, 2088.
- N. pringlei* Robins. & Greenm.*
 $n=7$ MÉXICO: PUEBLA: 25 mi SW of Tehuacán on Hwy 125, 2061.
- N. propinquum* Morton & C. L. Hitchc.*
 $n=7$ MÉXICO: COAHUILA: 86 mi N of Múzquiz on Hwy 93, 1819, 1819a.
- N. prostratum* Brand*
 $n=7$ MÉXICO: JALISCO: E side of Nevado de Colima, 1979.
- N. pusillum* Lemm. ex Gray
 $n=7$ UNITED STATES: CALIFORNIA: Inyo Co.: 11 mi S of Big Pine, 1801. NEVADA: Clark Co.: 33 mi NE of Tecopah, 1859.
- N. retrorsum* J. T. Howell*
 $n=7$ UNITED STATES: NEW MEXICO: Sandoval Co.: 9.3 mi E of San Ysidro on Hwy 44, 1695.
- N. rothrockii* Gray
 $n=17$ UNITED STATES: CALIFORNIA: Inyo Co.: 10 mi W of Lone Pine on Whitney Portal road, 1812; Onion Valley, 1813.
- N. rotundifolium* (Gray) Macbr.*
 $n=7$ MÉXICO: COAHUILA: 4 mi E of Sacramento, *Hartman & Funk* 3967.

TABLE 1. CHROMOSOME NUMBERS IN *NAMA* (CONTINUED)

- N. sandwicense* Gray
 $n=7$ UNITED STATES: HAWAII: Oahu: near Waimanalo Beach Park, Eggleston *s.n.* (counts from plants grown from seeds of this collection).
- N. sericeum* Willd. ex. Roem. & Schult.
 $n=7$ MÉXICO: HIDALGO: 14 mi N of Zimapán on Hwy 85, 1724; 4 mi N of Mezquititlán, 1758; 19 mi SW of Jacala on Hwy 85, 1832. TAMAULIPAS: 18 mi N of Jaumave on Hwy 101, 1837.
- N. serpylloides* Gray ex Hemsl. var. *confertum* I. M. Johnst.*
 $n=7$ MÉXICO: COAHUILA: 4 mi S of Cuatro Ciénegas on Hwy 30, 1824.
- N. serpylloides* Gray ex Hemsl. var. *velutinum* C. L. Hitchc.
 $n=7$ MÉXICO: COAHUILA: near Hermanas, Hartman & Sanderson 35416, 1820.
- N. stevensii* C. L. Hitchc. var. *gypsicola* (I. M. Johnst.) Bacon
 $n=7$ MÉXICO: NUEVO LEÓN: 16 mi W of Iturbide on Hwy 58, 1896; 2 mi E of San Roberto Jct., 1905. ZACATECAS: 26 mi S of Coahuila-Zacatecas boundary on Hwy 54, 1912.
- N. stevensii* C. L. Hitchc. var. *stevensii*
 $n=7$ UNITED STATES: NEW MEXICO: Eddy Co.: 6 mi N of Texas-New Mexico boundary on Hwy 62, 1851. OKLAHOMA: Beckham Co.: 12 mi S of Erick on Hwy 30, 1871. Jackson Co.: 21 mi SW of Altus on Hwy 6, 1872.
- N. turneri* Bacon
 $n=7$ MÉXICO: NUEVO LEÓN: 2 mi N of Pablillo, 1899 (and as *N. organifolium* var. *organifolium* in Bacon, 1974).
- N. undulatum* H. B. K. var. *undulatum*
 $n=7$ SOUTH AMERICA: ARGENTINA: Mendoza: below Cruz del Paramillo, Richardson 2020.
- N. xylopodium* (Woot. & Standl.) C. L. Hitchc.*
 $n=7$ UNITED STATES: NEW MEXICO: Eddy Co.: Sitting Bull Falls, 1853. TEXAS: Culberson Co.: Pine Canyon, Sikes & Smith 533.

*Taxon not previously reported.

Presently, *N. dichotomum* is structured of five varieties, vars. *dichotomum*, *chasmogamum*, *latisepalum* (Loes.) C. L. Hitchc., *pueblense* and *amplifolium* C. L. Hitchc., the latter South American (Hitchcock, 1933). Aside from the fact that these taxa generally exhibit relatively small, white corollas and brown seeds with prominent depressions, I can find little to support their close alliance. Indeed, field observations suggest that the North American taxa should be recognized as species. I have witnessed these taxa in various sympatric combinations in México. Careful searching of these mixed populations has revealed no evidence suggestive of hybridization. B. L. Turner (pers. comm.) confirms these observations for sympatric populations of vars. *dichotomum* and *pueblense* in the state of Veracruz, México. Moreover, numerous herbarium sheets, on loan from ENCB, GH, LL, MEXU, MICH, MO, NY, TEX, UC and US, consist of various mixed collections of these taxa. In all cases, the taxa are clearly distinct. Nature's test for species status

appears to be met among these taxa. Chromosome numbers, initially reported herein, clearly differentiate the var. *chasmogamum* from the vars. *dichotomum* and *pueblense*. Indeed, the var. *chasmogamum* differs from all members of the group in possessing corollas about 10 mm long as compared to about 6 mm for the others. Moreover, this taxon, judging from label data, apparently comprises two corolla color morphs, a blue morph and a white morph. Included counts for this variety are both from populations with blue corollas. This form exhibits tubular-weakly salverform corollas, while those of the white form, which I have yet to encounter in the field, are broader and more campanulate. Habitally, the two forms are quite similar. Possibly, the var. *chasmogamum* houses two entities. Additionally, I am of the opinion that the var. *latisepalum* is misplaced in the *dichotomum* group. In habit, leaf and sepal characters, the variety is much more reminiscent of *N. hirsutum* than of any taxon in the *dichotomum* assemblage. Seed features of the variety, under the light microscope (x 50), also are more reminiscent of *N. hirsutum* than of yet other varieties with which it is presently aligned. Ultrastructural studies of seeds of these taxa are underway. While I feel that the North American taxa of *N. dichotomum* should be treated as species, a formal change is required to elevate the var. *chasmogamum*. Therefore, I retain them here as varieties, pending further supporting evidence, so as not to add, even potentially, to the already lengthy synonymy of *Nama*.

With this report, chromosome numbers are available for 44 taxa of *Nama*. Only five are consistently polyploid. Additionally, two species are reported as both diploid and tetraploid, but the latter ploidy level is represented by single reports against several at the diploid level. Included among the consistently polyploid taxa is the chromosomally anomalous *N. rothrockii* as well as *N. lobii*. The inclusion of these species in *Nama* has been questioned on the basis of morphology and cytology (Bacon, 1974, Raven and Axelrod, 1978) and seed coat structure (Chance and Bacon, 1984). Moreover, flavonoid chemistry of the two is unique among examined names (Bacon, in prep.). Available data countenance the position that these taxa should be viewed as elements phyletically distinct from *Nama*. Nevertheless, adopting a conservative view, accepting *Nama* as presently structured and including as polyploid any taxon for which a polyploid count is reported, the percentage of polyploidy in the genus is slightly less than 16%. This percentage is very low as compared to general estimates of polyploidy in dicots (e.g. Grant, 1963) and somewhat less than that reported in other "cytologically conservative" groups, such as *Penstemon* (Freeman, 1983). It seems likely that *Nama*, as implied by Bacon (1974), will be noted as an example of a diverse group in which speciation has occurred predominantly at the diploid level.

ACKNOWLEDGEMENTS

I wish to thank Dr. Mario Sousa, Jefe del Herbario Nacional, UNAM, for

his cooperation and assistance which greatly expedited field work in México. This study was supported by NSF Grant DEB 8108513.

REFERENCES

- BACON, J. D. 1974. Chromosome numbers and taxonomic notes in the genus *Nama* (Hydrophyllaceae). *Brittonia* 26:101–105.
- . 1981. New species of *Nama* (Hydrophyllaceae) from the Chihuahuan Desert region of Mexico. *Sida* 9:99–103.
- CAVE, M. S. and L. CONSTANCE. 1947. Chromosome numbers in the Hydrophyllaceae: III. Univ. Calif. Publ. Bot. 18:449–465.
- . 1950. Chromosome numbers in the Hydrophyllaceae: IV. Univ. Calif. Publ. Bot. 23:363–382.
- . 1959. Chromosome numbers in the Hydrophyllaceae. V. Univ. Calif. Publ. Bot. 30:233–258.
- CHANCE, G. D. and J. D. BACON. 1984. Systematic implications of seed coat morphology in *Nama* (Hydrophyllaceae). *Amer. J. Bot.* 71:829–842.
- CONSTANCE, L. 1963. Chromosome number and classification in Hydrophyllaceae. *Brittonia* 15:273–285.
- FREEMAN, C. C. 1983. Chromosome numbers in Great Plains species of *Penstemon* (Scrophulariaceae). *Brittonia* 35:232–238.
- GRANT, V. 1963. The origin of adaptations. Columbia University Press, New York. 435 pp.
- HITCHCOCK, C. L. 1933. A taxonomic study of the genus *Nama*. *Amer. J. Bot.* 20:415–430, 518–534.
- . 1939. The perennial Mexican namas. *Amer. J. Bot.* 26:341–347.
- JOHNSTON, I. M. 1941. Gypsophily among Mexican desert plants. *J. Arnold Arbor.* 22:145–170.
- RAVEN, P. H. and D. I. AXELROD. 1978. Origin and relationships of the California flora. Univ. Calif. Publ. Bot. 72:1–134.
- SMITH, L. 1947. The acetocarmine smcar technic. *Stain Tech.* 22:17–31.
- WATERFALL, U. T. 1946. Observations on the desert gypsum flora of southwestern Texas and adjacent New Mexico. *Amer. Mid. Nat.* 36:456–466.

BIOSYSTEMATIC STUDY AND TYPIIFICATION OF THE CALIFORNIAN COREOPSIS (COMPOSITAE) SECTIONS *TUCKERMANNIA*, *PUGIOPAPPUS*, AND *EULEPTOSYNE*

EDWIN B. SMITH

*Department of Botany and Microbiology,
University of Arkansas, Fayetteville, AR 72701, U.S.A.*

ABSTRACT

Biosystematic study and study of type and other material of the eight species of Californian *Coreopsis* (sections *Tuckermannia*, *Pugiopappus*, and *Euleptosyne*) was undertaken. The group is resistant to the biosystematic approach, in the sense that artificial hybridizations attempted in all combinations among the species were mostly unsuccessful. Only *C. maritima* X *C. gigantea* hybrids (and the reciprocal) were produced and these had high pollen stainability. All eight species in the three sections are $n = 12$. The perennials (section *Tuckermannia*) have noticeably larger meiotic chromosomes than do the annuals (sections *Pugiopappus* and *Euleptosyne*). The three sections are well-differentiated and deserve sectional status. A key to the taxa and citation of observed types and other specimens examined is presented. Based on selected morphological characteristics, the relative evolutionary advancement of the species within each section is postulated.

INTRODUCTION

This paper continues a biosystematic study of *Coreopsis* (Compositae) and will largely complete work on the biosystematic aspects of the North American species of *Coreopsis* north of Mexico. Earlier papers have included, for examples, work on *C. saxicola* (Smith, 1973), the disk flower lobing and sectional status of North American *Coreopsis* (Smith, 1972), a description of a new species (Smith, 1974), and a biosystematic survey of the eastern United States and Canadian species of the genus (Smith, 1976). Some recent work has involved collaborative chemosystematic study, for examples, flavonoid chemistry of section *Palmatae* of *Coreopsis* (Crawford, Smith, & Mueller, 1980), of selected species in section *Coreopsis* (Crawford & Smith, 1980; Smith & Crawford, 1981) and at the sectional level in North American *Coreopsis* (Crawford & Smith, 1983a), allozyme variation in certain species pairs (Crawford & Smith, 1982a, b) and in the varieties of *C. grandiflora* (Crawford & Smith, 1984a), and anthochlor floral pigments in North American *Coreopsis* (Crawford & Smith, 1983b). Phyletic trends of the sections of North American *Coreopsis* were suggested earlier (Smith, 1975).

This paper is concerned with the results of biosystematic study and typi-

fication of the Californian *Coreopsis*, a group of eight species in three sections limited largely to California. Two of the species range into Arizona and Baja, California, Mexico. A new variety of *C. californica*, endemic to Arizona, was recently described by the author (Smith, 1983). This group was the subject of an excellent paper by Sharsmith (1938) that clarified the morphology and ranges of the species but which did not clearly typify the species in the group. The group was also treated as part of the genus (Sherff, 1936) and part of the North American portion of the genus (Sherff, 1955), also without clear typification. Recent leaf flavonoid studies of sections *Pugiopappus* and *Euleptosyne* (Crawford & Smith, 1984b) provide chemical data that are not concordant with the clearcut morphological differences between these two sections. The present paper will not be concerned with detailed morphological descriptions or illustrations of the species, since these were generally well-presented by Sharsmith (1938), but with the results of biosystematic study of the species, with the probable relative evolutionary advancement of the species within each section, and with the typification of the species in the group.

MATERIALS AND METHODS

Live material, achenes, and preserved buds of the species were collected in 1980 and 1981 on field trips to Arizona, California, and Baja California. Live material was transplanted to the greenhouse, or raised from field-collected achenes (one sample each of *C. gigantea* and *C. maritima* was kindly furnished by the Rancho Santa Ana Botanic Garden). Artificial hybridizations were attempted in all combinations in the greenhouse. Heads were bagged with lens paper prior to anthesis. They were uncovered briefly after anthesis of the outer few rows of disk flowers, and the pollen-covered disk-flower stigmas of the respective parents were gently rubbed together and then rebagged until fruit set. Some heads of each species were bagged and left bagged to check for self-compatibility. Selected crosses were attempted between the Californian species of *Coreopsis* and species of other sections, to check for intersectional crossability.

Germination of achenes, especially of the annual species, was poor under standard procedures (on moist filter paper in petri dishes), but reasonably adequate germination was obtained by leaching the achenes in a cheesecloth bag for three days in running tap water, then dissecting out each embryo (onto moist filter paper in petri dish). All seedlings were transplanted into a half soil/half sand mixture in clay pots in the greenhouse.

Buds harvested in the field and greenhouse were squashed by the anther squash technique in 1% propiocarmine stain after fixation for one to several days in a modified Carnoy's fixative (ethyl alcohol, propionic acid, chloroform; 3:1:1), as in previous papers in this series (e.g. Smith, 1983, 1982).

Percentage pollen stainability of the parental and hybrid stock was tested in analine blue (alcohol soluble, 1% by weight in 90% propionic acid/

water), with a minimum of 300 pollen grains scored per individual; deeply blue grains were counted as stainable and pollen stainability was equated with fertility.

Herbarium material of the eight species was examined from nine herbaria in California and Arizona and from PH. In addition, some of these herbaria and 16 other herbaria were contacted in attempts to locate and examine type material of all of the California species of *Coreopsis*.

RESULTS AND DISCUSSION

Biosystematic work:

All eight species grew and flowered in the greenhouse soil mixture, indicating that the odd habitats where some of them are often found (e.g., serpentine soils for *C. douglasii*, shale slopes for *C. hamiltonii* and *C. bigelovii*) are not obligate for the species. One species, *C. gigantea*, tended to die from root rot unless planted directly in the ground in the greenhouse.

All species of the three sections have high pollen stainability (90–99%), and all are self-incompatible as judged by failure of fruit set in bagged heads that were left bagged. *Coreopsis gigantea* and *C. bigelovii* exhibited a low level of selfing when stimulated by pollen from another species.

Approximately 20 intersectional hybridizations were attempted between various Californian species of *Coreopsis* and species in other sections (sect. *Coreopsis*, *Calliopsis*, *Eublepharis*, *Palmatae*, *Electra*, *Anathysana*, and *Pseudoagarista*). All intersectional hybridizations failed.

All eight species of the three sections are $n = 12$ (Fig. 1). The meiotic chromosomes of the perennials (sect. *Tuckermannia*) are much larger and easily distinguishable from those of the annuals (sect. *Pugiopappus* and *Euleptosyne*), but the chromosomes of each subgroup (annuals or perennials) are not easily distinguishable among themselves.

The California *Coreopsis* group is resistant to biosystematic analysis, in the sense that only one of the 28 possible artificial hybrid combinations (lumping reciprocals) was successful. The *C. maritima* X *C. gigantea* cross was reciprocally successful and produced several artificial F_1 hybrids. Only seven of these have flowered. They have the large, thick-stemmed, sprawling habit of *C. gigantea* but form few and large heads on elongate peduncles as in *C. maritima*. The average pollen stainability of the seven F_1 hybrids was 95%, falling within the range of the normal pollen stainability of the parental species. Several F_2 and BC_1 hybrids (*C. maritima* the repeating parent) are under cultivation, but most of these have not bloomed yet. Four F_2 hybrids (resembling *C. gigantea* or the F_1) averaged 65% pollen stainability, and five BC_1 hybrids (resembling *C. maritima*) averaged 92% pollen stainability. Such high fertility in both first and second generation hybrids between *C. maritima* and *C. gigantea* strongly suggests that *C. gigantea* should be reduced to a variety of *C. maritima* (the older name). However, since

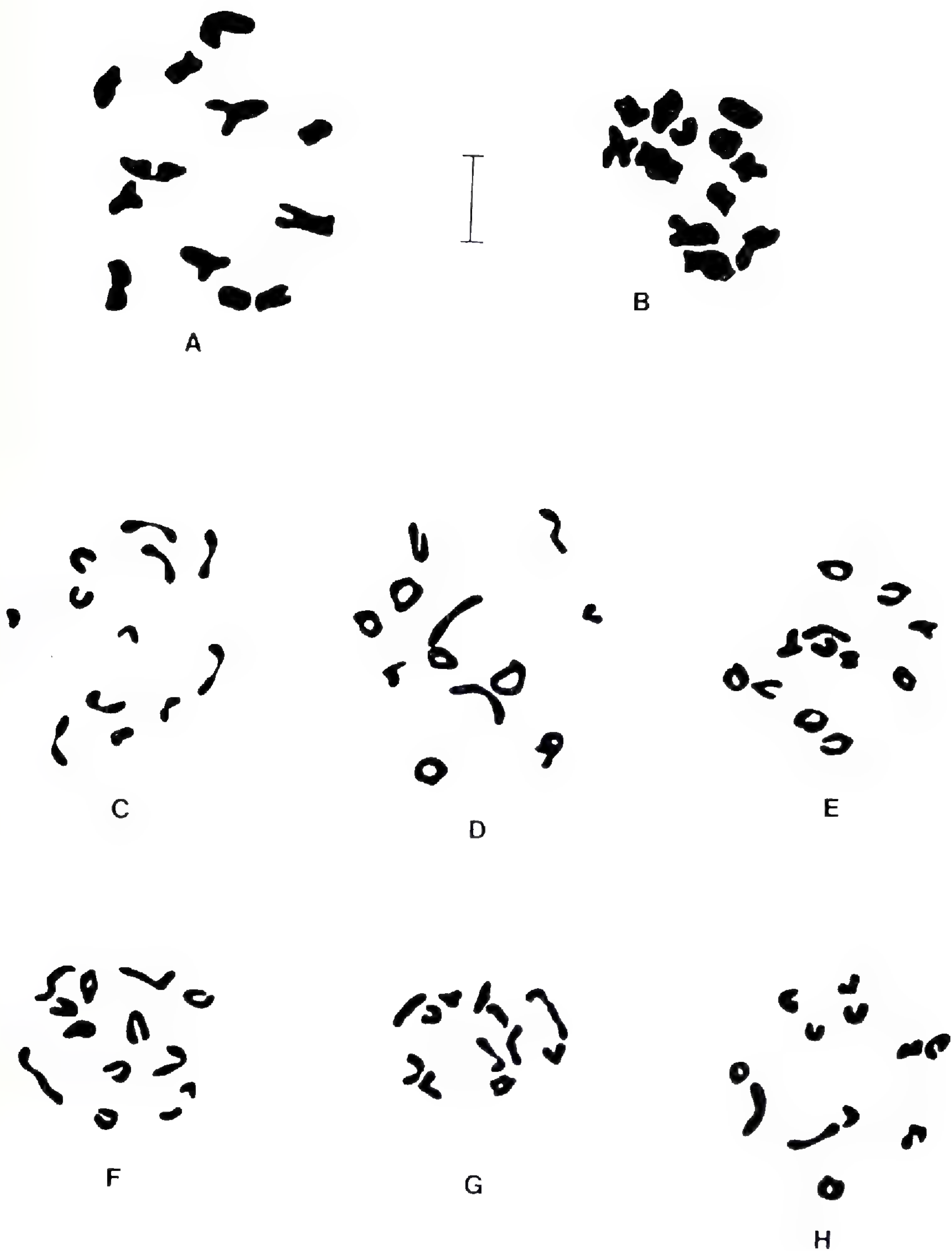


Figure 1. Meiotic configurations (diakinesis) of the Californian *Coreopsis*; inked-in tracings from photographs. Top row = section *Tuckermannia*, middle row = section *Pugiopappus*, bottom row = section *Euleptosyne*; A = *C. gigantea*, B = *C. martima*, C = *C. calliopsidea*, D = *C. bigelovii*, E = *C. hamiltonii*, F = *C. stillmanii*, G = *C. dogulasii*, H = *C. californica* var. *californica*; all $n = 12$; reference bar = 10 μm .

I noted no natural hybrids in the field or in herbarium materials, and the ranges of the two do not overlap (cf. Sharsmith, 1938), it seems best to maintain *C. gigantea* at the species level.

Key and taxonomic treatment:

Below is a key (modified from Sharsmith, 1938; in part from Smith, 1983) to the taxa of sections *Tuckermannia*, *Pugiopappus*, and *Euleptosyne*, followed by a taxonomic treatment including typification, brief descriptions, comments on relative evolutionary advancement of the species within each section, and citation of specimens examined. Blooming times are not indicated, since all eight species bloom mostly in the period March-May.

1. Plants perennial, commonly 3–20 dm tall; heads (measured from ligule tip to the opposite ligule tip) medium-sized to large, commonly 4–10 cm wide; ligules 10–20, elliptical-oblong to elliptical-oblongate; coast and offshore islands (section *Tuckermannia*).
2. Heads several to many and medium-sized (ca 4–8 cm wide), cymosely clustered, on peduncles ca 6–20 cm long; stem solid; Los Angeles County to Monterey County and adjacent islands (and Guadalupe Island, Mexico) 1. *C. gigantea*
2. Heads few (ca 2–4) and large (ca 6–10 cm wide), on peduncles ca 15–50 cm long; stem hollow; San Diego County to Baja California Norte and nearby adjacent islands 2. *C. maritima*
1. Plants annual, commonly 0.8–4.0 dm tall; heads (measured as above) small to medium-sized, ca 1–7 cm wide; ligules 5–12, obovate; mountains and deserts.
3. Achenes dimorphic, the ray achenes glabrous and epappose, the disk achenes antrorsely villous, ciliate, and aristate with two aristae (section *Pugiopappus*).
4. Outer phyllaries ovate; pappus aristae ca 4 mm long 3. *C. calliopsidea*
4. Outer phyllaries linear-oblong; pappus aristae ca 0.9–2.8 mm long.
5. Pappus aristae ca 1.7–2.8 mm long; chaff basally adnate to and falling with the disk achenes; ligules remaining horizontal in full anthesis 4. *C. bigelovii*
5. Pappus aristae ca 0.9–1.3 mm long; chaff free from and falling separately from the disk achenes; ligules at first horizontal, becoming reflexed in full anthesis 5. *C. hamiltonii*
3. Achenes monomorphic, both ray and disk achenes epappose, eciliate, and more or less bearing tiny short-clavellate trichomes (section *Euleptosyne*).
6. Leaves flat, pinnate to bipinnate into spatulate lobes ca 1–3 mm wide; outer phyllaries bearing few to several tiny, setose, gland-tipped teeth on the margins near the base 6. *C. stillmanii*
6. Leaves linear-filiform, entire or with a few linear-filiform lobes, the leaves (or lobes) 0.3–1.3 mm wide; outer phyllaries lacking gland-tipped teeth basally.
7. Achenes shining, glabrous or nearly so, the body dark brown and lacking reddish-brown (blackish) spots, the wing thin 7. *C. douglasii*
7. Achenes dull, bearing several to many tiny short-clavellate trichomes, the body tan to brownish or reddish and commonly

with several to many reddish-brown (blackish) spots (best seen on immature achenes), the wing at least partially corky-thickened.

8. Mature achenes 3.0–4.3 mm long, the wings 0.3–0.7 mm wide and corky-thickened throughout; immature achenes with 0–few reddish-brown (blackish) spots in a single row at each margin of the body; southern California and Baja California, Mexico 8a. *C. californica* var. *californica*
8. Mature achenes 4.6–6.3 mm long, the wings 0.8–1.5 mm wide and corky-thickened near body but thin near margin; immature achenes with numerous reddish-brown (blackish) spots more or less scattered on the body (not confined to a single row at each margin); Arizona .. 8b. *C. californica* var. *newberryi*

Section TUCKERMANNIA (Nutt.) Blake, Proc. Amer. Acad. 49:340. 1913.

Tuckermannia Nutt., Trans. Amer. Phil. Soc. II. 7:363, as genus. 1841.

Leptosyne sect. *Tuckermannia* A. Gray, Bot. Calif. 1:356. 1876.

TYPE SPECIES: *Coreopsis maritima* (Nutt.) Hook f.

1. COREOPSIS GIGANTEA (Kellogg) H. M. Hall, Univ. Calif. Publ. Bot. 3:142. 1907.

TYPE: U.S.A. CALIFORNIA. Santa Barbara Co.: Santa Rosa Island, bottom of Cherry Canyon, 5–7 Apr 1960, *P. H. Raven 14965A* (NEOTYPE, here designated: JEPS!).

Leptosyne gigantea Kellogg, Proc. Calif. Acad. Sci. 4:198. 1873. TYPE: U.S.A.

CALIFORNIA: Cuyler Harbor on San Miguel Island, *W. G. W. Harford s.n.*, not located.

Tuckermannia gigantea (Kellogg) M. E. Jones, Contr. W. Bot. 15:74. 1929.

Additional specimens examined: U.S.A. CALIFORNIA. Los Angeles Co.: 29 Apr 1918, *Evermann s.n.* (CAS); *Fosberg S4420* (PH, two sheets); *Grant 680-2228* (PH); *Raven 13852* (JEPS), 17848 (UC); Jan & Feb 1903, *Saunders s.n.* (PH); *Thomas 484* (DS), 6503 (DS); *Wolf 3631* (LA). Monterey Co.: *Balls 12191* (UC); 24 May 1923, *Walther s.n.* (CAS). San Luis Obispo Co.: *Chisaki & Kamb 1811* (UC). Santa Barbara Co.: *Abrams & Wiggins 129* (CAS); *Breedlove 2821* (DS); *Ferris 7572* (UC); *Fosberg S953* (PH), S1982 (PH), S2334 (PH), 7568 (LA, PH); Jul & Aug 1886, *Greene s.n.* (PH); *Keck & Hiesy 5112* (DS); 24 May 1918, *Miller s.n.* (CAS); *Wiggins 3487* (DS). Ventura Co.: *Bacigalupi 5776* (JEPS); *Bright 8134* (UARK); *French 320* (UC); *Howell 3793* (CAS); 20 Jun 1970, *Pollard s.n.* (CAS); *Shreve 8207* (ARIZ); *Smith 3584* (UARK), 3604 (UARK, two sheets); *Thompson 1861* (JEPS); *Wheeler 488* (DS). MEXICO. Baja California: *Kuijt et al. 1049* (UC); *Moran 2923* (DS); *Palmer 41* (PH).

A large (commonly 1–2 m tall), fleshy-stemmed (the stem commonly 4–10 cm in diameter) and many-flowered (heads 4–8 cm wide) perennial with finely dissected leaves (ultimate segments ca 0.5–1.5 mm wide), of rocky cliffs and seacoasts of southern California on the mainland and offshore islands, from Los Angeles County and Santa Catalina Island north to Santa Rosa Island and Monterey County (also known from Guadalupe Island, Mexico).

Because of its larger growth habit and numerous heads, I consider this species to be the more primitive one in section *Tuckermannia*.

2. *COREOPSIS MARITIMA* (Nutt.) Hook. f., Bot. Mag. t. 6241. 1876.

TYPE: U.S.A. CALIFORNIA. San Diego Co.: On shelving rocks, near the sea at St. Siego, in upper California, *Nuttall s.n.* (LECTOTYPE, here designated: BM!).

Tuckermannia maritima Nutt., Trans. Amer. Phil. Soc. n. ser. 7:363. 1841.

Leptosyne maritima (Nutt.) A. Gray, Proc. Amer. Acad. 7:358. 1868.

Additional specimens examined: U.S.A. CALIFORNIA. San Diego Co.: *Bacigalupi* 5786 (JEPS); *Bartram* 586 (PH); *Clements & Clements* 226 (PH); *Dunn* 824 (LA); 30 Mar 1932, *Epling & Robison s.n.* (LA); *Lewis* 1220 (LA); *Moran* 2091 (UC), 2095 (UC); 25 Apr 1882, *Pringle s.n.* (PH); *Smith* 3585 (UARK); *Thomas* 6975 (DS); *Wolf* 1929 (ARIZ, CAS, DS, UC). MEXICO. Baja California: *Chandler* 5123 (UC); *Cooper* 2144 (UC); 1 Apr 1947, *Copeland s.n.* (DS); 5 Mar 1971, *Cummins s.n.* (ARIZ); 27 Mar 1940, *Epling & Robison s.n.* (LA); 7 Apr 1936, *Epling & Stewart s.n.* (DS, LA); 7 Apr 1951, *Flemming s.n.* (UC); *Fosberg* 51123 (PH); *Hendrickson* 4591 (ASU), 4612 (ASU); *Jones* 3134 (DS, PH, UC), 10 Jun 1926, *Jones s.n.* (DS); *Kappler* 798 (LA); *Moran* 3059 (UC), 8282 (DS, UC), 10556 (DS); *Smith* 3586 (UARK), 3587 (UARK); *Thomas* 12 (DS); *Wiggins* 5112 (CAS, DS, UC), 11971 (UC), 11985 (DS, UC), 13062 (DS).

A smaller (mostly 0.3–0.8 m tall), hollow-stemmed (the stem commonly 1–2 cm in diameter), and few-flowered (heads 6–10 cm wide) perennial from a carrot-like root with less finely dissected leaves (ultimate segments ca 1–4 mm wide) of rocky seacoasts of Baja California and offshore islands and of San Diego County, California.

Because of its smaller size, semi-scapose habit, and fewer heads, I consider this species to be the more advanced member of section *Tuckermannia*. *Coreopsis maritima* has the largest heads of all North American species of the genus. The scapose habit in North American *Coreopsis* is considered a derived condition and is often accompanied by increase in head size.

Section *PUGIOPAPPUS* (A. Gray) Blake, Proc. Amer. Acad. 49:340. 1913.

Agarista DC., Prodr. 5:569, as genus. 1836 (but not of other authors).

Pugiopappus A. Gray in Torr. Pacif. Railr. Rep. 4:104, as genus. 1857.

Leptosyne sect. *Pugiopappus* A. Gray, Syn. Fl. N. Amer. 1(2):300. 1884.

TYPE SPECIES: *Coreopsis calliopsidea* (DC.) A. Gray

3. *COREOPSIS CALLIOPSIDEA* (DC.) A. Gray, Bot. Mex. Bound. 90. 1859.

TYPE: U.S.A. CALIFORNIA: without locality, *Douglas* 49 (LECTOTYPE, here designated: BM!; ISOLECTOTYPES, here designated: K two sheets!).

Agarista calliopsidea DC., Prodr. 5:569. 1836.

Pugiopappus calliopsidea (DC.) A. Gray, Proc. Amer. Acad. 8:660. 1873.

Leptosyne calliopsidea (DC.) A. Gray, Syn. Fl. N. Amer. 1(2):300. 1884.

Leptosyne calliopsidea var. *nana* A. Gray, Syn. Fl. N. Amer. 1(2):300. 1884.

TYPE: U.S.A. CALIFORNIA. San Bernardino Co.: At Mohave station, etc., *Pringle s.n.* (LECTOTYPE, here designated: CAS!; ISOLECTOTYPES, here designated: F two sheets!, GH!, MO!, NY!).

Additional specimens examined: U.S.A. CALIFORNIA. Alameda Co.: *Carter* 777 (DS); *Eastwood & Howell* 1939 (DS); *Hoover* 1750 (JEPS). Fresno Co.: *Hoover* 4779 (JEPS, UC). Kern Co.: *Abrams* 11184 (DS); *Alva* 1868 (JEPS); *Davy* 1871 (UC); *Ferris* 9036 (DS, UC), 9131 (DS); *Fosberg* S1134 (PH); *Gould* 901 (ARIZ); *Heller* 7723 (DS two sheets, PH, UC); *Keck & Clausen* 3177 (DS); *Meng* 516 in part (CAS); *Smith* 3493 (UARK two sheets), 3579 (UARK); *Twisselman* 15062 (CAS two sheets), 15129 (CAS); *Wiggins* 9559 (DS); *Wolf* 6360 (ARIZ, LA). Kings Co.: *Bacigalupi & Macbride* 3547 (CAS, DS, JEPS); *Hoover* 4269 (JEPS, UC). Los Angeles Co.: *Bacigalupi* 4816 (JEPS); *Holmgren & Holmgren* 7625 (ASU); *Wolf* 8522 (ARIZ, DS, LA). Merced Co.: *Lyon* 1039 (UC). Monterey Co.: *Hoover* 2983 (DS, JEPS, UC). San Benito Co.: 24 Apr 1940, *Carpenter s.n.* (JEPS). San Bernardino Co.: 8 Apr 1938, *Beal s.n.* (JEPS); 6 Apr 1936, *Lewis s.n.* (LA); *McLeod et al.* 12141 (ASU); *Nordstrom* 348 (UC); *Smith* 3577 (UARK); *Tilforth et al.* 1556 (UC); *Twisselmann* 12050 (CAS two sheets, JEPS). San Joaquin Co.: *Hoover* 2869 (JEPS, UC). San Luis Obispo Co.: *Breedlove* 1979 (DS); *Fosberg* S1226 (PH); *Hoover* 10279 (UC), 11037 (UC); *Jepson* 16223 (JEPS); *Keck & Clausen* 3090 (DS two sheets); *Raven* 16965 (DS); *Twisselmann* 556 in part (CAS), 1758 (CAS). Santa Barbara Co.: *Breedlove* 1940 (DS); *Keck* 2243 (DS two sheets); *Muntz* 13619 (DS); *Raven* 16985 (DS two sheets, JEPS). Stanislaus Co.: *Hoover* 857 (JEPS); *Sharsmith* 1593 (UC). County not specified: *Anderson* 107/64 (UARK); 14 May 1882, *Pringle s.n.* (K, PH two sheets).

An annual commonly 10–40 cm tall, with leaves borne up the stem, ovate outer phyllaries (ca 4–5 mm wide), large heads (mostly 3–7 cm in diameter), chaff attached to the disk achenes, and aristae of the disk achenes ca 4 mm long, of sandy open soils of western San Bernardino and northern Los Angeles counties northwestward to Alameda and San Joaquin counties, California.

Seedlings of this species have three (sometimes four) cotyledons, a unique character for North American *Coreopsis*. Largely because of its broad outer phyllaries, relatively large size, leafy stem, and long pappus aristae of the disk achenes, I consider this species to be the most primitive member of section *Pugiopappus*.

4. COREOPSIS BIGELOVII (A. Gray) H. M. Hall, Univ. Calif. Publ. Bot. 3:141. 1907.

TYPE: U.S.A. CALIFORNIA. San Bernardino Co.: On the Mohave Creek, in the desert east [west] of Colorado [River], Mar 1854, *J. M. Bigelow s.n.* (LECTOTYPE, here designated: GH!; ISOLECTOTYPE, here designated: NY!).

Pugiopappus bigelovii A. Gray, Pacif. Railr. Rep. 4:104. 1857.

Pugiopappus breweri A. Gray, Proc. Amer. Acad. 7:660. 1873. TYPE: U.S.A. CALIFORNIA. Ventura Co.: On dry hills at San Buenaventura, *Brewer* 241 (LECTOTYPE, here designated: GH!; ISOLECTOTYPE, here designated: K!).

Leptosyne bigelovii A. Gray, Syn. Fl. N. Amer. 1(2):300. 1884.

Additional specimens examined: U.S.A. CALIFORNIA. Fresno Co.: *Bacigalupi* 6387 (JEPS), 6996 (JEPS); *Constance & Beetle* 2560 (JEPS, UC); *Ferris & Bacigalupi* 13355 (JEPS); *Hoover* 2943 (JEPS, UC); *Jepson* 2763 (JEPS), 15400 (JEPS two sheets); *Kappler* 1851 (LA); *Pawek* 29 (DS); *Wiggins* 12016 (DS, UC). Inyo Co.: *Ferris et al.* 3953 (DS); *Fosberg* S227 (PH), 5295 (PH); 18 Apr 1937, *Kerr s.n.* (CAS); *Pennell & Muntz* 25049 (PH); 15 May 1891, *Schockley s.n.* (UC); *Steward*

& Steward 7380 (ASU); 6 Apr 1937, Train *s.n.* (ARIZ); Turner C516 (LA); Twisselmann 2553 (CAS). Kern Co.: 18 Apr 1915, Evermann *s.n.* (CAS); Ferris 1710 (DS); Fosberg S1332 (PH); Heller 7662 (PH); Hood 39-3* (LA two sheets); Linsley & MacSwain 60-21 (UC); Meng 516 in part (CAS); Rose 48067 (ARIZ), Smith 228 (ARIZ), 934 (JEPS); Twisselmann 3374 (CAS), 4995 (CAS, JEPS). Los Angeles Co.: Abrams 13868 (DS), Bacigalupi 4387 (ARIZ, CAS); Blakley 2269 (JEPS); Clokey & Templeton 4520 (PH, UC two sheets); 27 Mar 1954, Hogue *s.n.* (LA); Hoover 3120 (JEPS, UC); 25 Mar 1961, Lindholm *s.n.* (DS); 9 Apr 1936, McClintock *s.n.* (LA); Smith 3598 (UARK); Thompson 1905 (JEPS); Tilforth *et al.* 1529 (UC); Twisselmann 8367 (JEPS). Monterey Co.: Eastwood 4022 (CAS). Riverside Co.: Ray 1362b (JEPS). San Bernardino Co.: Alexander & Kellogg 2009 in part (UC); Bacigalupi 6227 (JEPS); Beal 11 (JEPS), 742 (JEPS), 777 (JEPS); Carter 2305 (DS, LA); Fosberg S1687 (PH), S2766 (PH), 5578 (PH), 8213 (PH); 13 Mar 1917, Hart *s.n.* (CAS); Lewis 1387 (LA); Raven 11936 (JEPS); Smith 3575 (UARK); 6 Apr 1937, Train *s.n.* (UARK); Wolf 6471 (ARIZ in part, DS, LA), 6533 (ARIZ). San Luis Obispo Co.: Hoover 3105 (JEPS), 10455 (ASU), 10493 (UC); Smith 3583 (UARK); Twisselmann 556 in part (CAS), 1762 (CAS); Wolf 6458 (ARIZ, LA). Santa Barbara Co.: Bittman 23 (ARIZ); Elakley 3454 (JEPS), 4291 (JEPS); 9 Apr 1938, Epling *s.n.* (LA); Kappler 2182 (LA); Smith 3603 (UARK). Tulare Co.: 27 Mar 1911, Farr *s.n.* (PH); Ferris 12174 (DS, UC); Robbins & Heckard 3547 (JEPS). Ventura Co.: DeBuhr & Wainwright 563 (ASU); 24 Mar 1917, Evermann *s.n.* (CAS); Kamb & Chisaki 2212 (ARIZ); Kappler 1844 (LA). County not specified: Coville & Funston 742 (PH); Hall 3027 (DS); 16 May 1903, Jones *s.n.* (DS); Parish 226 (PH); 11 May 1882, Pringle *s.n.* (PH); 1882, Pringle *s.n.* (PH); Smith 71001 (UARK).

An annual commonly 10–35 cm tall, with leaves mostly or entirely basal, linear outer phyllaries (ca 1.0–1.5 mm wide), medium-sized heads (mostly 2.5–5.5 cm in diameter), chaff attached to the disk achenes, and aristae of the disk achenes ca 1.7–2.8 mm long, of open sandy and shaley soils from Riverside County northwest to Monterey and Fresno counties, California.

Largely because of its narrow outer phyllaries, relatively large size, semiscapose habit, and intermediate-length pappus aristae of the disk achenes, I consider this species to be intermediate evolutionarily in the section.

5. COREOPSIS HAMILTONII (Elmer) Sharsmith, Madroño 4:214. 1938.

TYPE: U.S.A. CALIFORNIA. Santa Clara Co.: Steep, loose, talus slope on southwest side of tributary canyon to Arroyo Bayo near base of Sugarloaf Mountain, Mount Hamilton Range, altitude 2100 ft, 25 Apr 1936, H. K. Sharsmith 3632 (NEOTYPE, here designated: UC!).

Leptosyne hamiltonii Elmer, Bot. Gaz. 41:323. 1906. TYPE: U.S.A. CALIFORNIA. Santa Clara Co.: Mount Hamilton, Apr 1900, A. D. E. Elmer 2328, not located.

Additional specimens examined: U.S.A. CALIFORNIA. Santa Clara Co.: Eastwood 11671 (CAS), 12468 (CAS); Howell 4665 (CAS); Jepson 4232 (JEPS); Raven 10944 (CAS, JEPS); Sharsmith 914 (UC), 1709 (UC), 1839 (UC), 3489 (UC), 3942 (UC), 3945 (UC); Smith 3580 (UARK). Stanislaus Co.: Ferris *et al.* 13091 (DS); Rodin 4928 (DS, UC).

A small (mostly 8–20 cm tall) annual with leaves basal, outer phyllaries

linear (ca 1 mm wide) and reflexed at maturity, small heads (mostly 1.2–1.5 cm in diameter), chaff free from the disk achenes, and aristae of the disk achenes ca 0.9–1.3 mm long, of exposed steep rocky and shaley slopes of Santa Clara and Stanislaus counties, California.

This is a rare species, deservedly listed as rare and endangered in California (Smith, Cole, & Sawyer, 1980) and is in category 2 in the national list of possibly endangered and threatened plants (Federal Register 48 (229):53648. 1983). Largely because of its narrow outer phyllaries, more or less scapose habit, and short pappus aristae of the disk achenes, I consider this species to be the most advanced member of section *Pugiopappus*.

Section EULEPTOSYNE (A. Gray) Blake, Proc. Amer. Acad. 49:341. 1913.

Leptosyne sect. *Euleptosyne* A. Gray, Syn. Fl. N. Amer. 1(2):299. 1844.

TYPE SPECIES: *Coreopsis douglasii* (DC.) H. M. Hall

6. COREOPSIS STILLMANII (A. Gray) Blake, Proc. Amer. Acad. 49:342. 1913.

TYPE: U.S.A. CALIFORNIA. [Probably in Sacramento Co.:] In the valley of the Upper Sacramento [River], *Stillman s.n.* (LECTOTYPE, here designated: GH!; ISOLECTOTYPES, here designated: NY two sheets!, F photograph and fragment!).

Leptosyne stillmanii A. Gray, Bot. Mex. Bound. 92. 1859.

Additional specimens examined: U.S.A. CALIFORNIA. Alameda Co.: 17 Jul 1980, *Rattan s.n.* (DS). Calaveras Co.: without date, *Hermann s.n.* (PH). Contra Costa Co.: Apr 1889, *Brandeggee s.n.* (UC). Madera Co.: *Hoover* 821 (JEPS, LA, UC), 4008 (JEPS). Mariposa Co.: *Bacigalupi & Heckard* 9009 (JEPS); *Congdon* 154 (DS); *Crum* 1916 (UC); *Mason* 11125 (UC); *Smith* 3599 (UARK). Placer Co.: *Jepson* 18583 (JEPS); Apr 1865, *Rattan s.n.* (DS). San Joaquin Co.: 11 Mar 1877, *Rattan s.n.* (DS). Santa Clara Co.: *Applegate* 259 (DS); *Breedlove* 4887 (DS, JEPS); *Kamb & Chisaki* 1680 (JEPS); *Sharsmith* 1959 (UC), 3054 (DS, UC); *Smith* 3582 (UARK). Stanislaus Co.: *Carter & Beetle* 1602 (ARIZ, JEPS, PH, UC); *Raven* 18147 (DS); *Sharsmith* 3536 (LA, UC). Tuolumne Co.: *Hoover* 1991 (DS, JEPS, UC); *Jepson* 18072 (JEPS); *Mason* 11019 (DS, LA, UC); *McNeal* 1230 (ASU).

A small (mostly 8–20 cm tall) annual with leaves mostly or entirely basal, the outer phyllaries few glandular-stipitate toothed on the margin basally, small heads (mostly 1.5–3.2 cm in diameter), relatively broad ultimate leaf segments (ca 1–3 mm wide), and achenes with corky wings and dull body, on arid grassy slopes on either side of the Sacramento and San Joaquin vallies from Butte to Tulare and Contra Costa to Stanislaus counties, California (Sharsmith, 1938).

The cotyledons in the achenes of this species are appressed in a plane tangential to the head, the normal orientation, as contrasted to radial plane orientation of the cotyledons in the achenes of the other two species of the section. Largely because of its relatively broad leaf segments, semi-scapose to scapose habit, relatively broader outer phyllaries, and the normal cotyledon

position, I consider this species to be the most primitive one in section *Euleptosyne*.

7. *COREOPSIS DOUGLASII* (DC.) H. M. Hall, Univ. Calif. Publ. Bot. 3:140. 1907 (as to name but not as to description).

TYPE: U.S.A. CALIFORNIA. without locality, *Douglas* 8 (LECTOTYPE, here designated: BM, plant C!; ISOLECTOTYPES, here designated: K two sheets!, GH, plant I!, UC fragment!).

Leptosyne douglasii DC., Prodr. 5:531. 1836.

Coreopsis stillmanii var. *jonesii* Sherff, Bot. Gaz. 97:605. 1936. TYPE: U.S.A. CALIFORNIA. Los Angeles Co.: Pasadena, 2 May 1882, *Marcus E. Jones* 3361 in part (locality in error; see Sharsmith, 1938) (HOLOTYPE: POM!; ISOTYPES: BM!, CAS!, DS two sheets!, NY two sheets!, UC!).

Additional specimens examined: U.S.A. CALIFORNIA. Monterey Co.: 25 Mar 1923, *Bacigalupi s.n.* (DS); *Crum* 1967 (DS, UC); *Eastwood & Howell* 1966 (UC); *Hoover* 2976 (UC), 2988 (JEPS, UC); *Shevock* 1378 (CAS). San Benito Co.: *Burgess* 130 (UC); *Ferris* 8394 (UC); *Keck* 2050 (DS); *Mason* 14733 (UC); *Raven* 10829 (UC). San Luis Obispo Co.: *Eastwood* 13858 (CAS); *Hardham* 4181B (CAS), 5254 (UC), 5518 (CAS); *Hoover* 7482 (DS, UC), 7484 (UC), 7769 (CAS), 9363 (UC); *Smith* 3581 (UARK), 3601 (UARK), 3602 (UARK); *Twisselmann* 2050 (CAS two sheets). Santa Barbara Co.: *Axtrod* 143 (UC). Santa Clara Co.: *Sharsmith* 3490 (UC), 3627 (DS, UC achenes), 3944 (UC), 15 Jun 1937, *Sharsmith s.n.* (UC).

A small (mostly 6–20 cm tall) annual with leaves entirely basal, the outer phyllaries entire, small heads (mostly 1–3 cm in diameter), narrow ultimate leaf segments (less than 1 mm wide) and achenes with thin wings and shiny, glabrous or nearly glabrous body, on dry rocky and serpentine slopes of the inner South Coast Ranges, from Santa Clara to Santa Barbara counties, California.

The cotyledons of the embryos in the achenes of this species, and the next, are appressed in a plane radial to the head. This unusual orientation links *C. douglasii* and *C. californica* as closely related and is another of the several characters that are similar in the two species. Largely because of its narrow leaf segment width, scapose habit, and its habitat (mountains vs desert), I consider this species to be intermediate (though close to *C. californica*) evolutionarily in section *Euleptosyne*.

8a. *COREOPSIS CALIFORNICA* (Nutt.) Sharsmith var. *CALIFORNICA*, Madroño 4:217. 1938.

TYPE: U.S.A. CALIFORNIA: Near San Diego, Upper California, Nuttall s.n. (LECTOTYPE, here designated: BM, upper three plants!; ISOLECTOTYPE, here designated: PH, two plants at upper left!).

Leptosyne californica Nutt., Trans. Amer. Phil. n. ser. 7:363. 1841.

Additional specimens examined: U.S.A. CALIFORNIA. Inyo Co.: *Twisselmann* 7102 (CAS two sheets, JEPS). Kern Co.: *Cantelow* 2130 (CAS); May 1927, *Epling s.n.* (LA); *Fosberg* S1333 (PH); 7 Apr 1932, *Hilend s.n.* (LA); *Hitchcock* 5825 (CAS);

29 May 1936, *Humphrey s.n.* (ARIZ); *Jepson* 15440 (JEPS), 15570 (JEPS); *Thomas* 7623 (JEPS); *Twisselmann* 10655 (JEPS). Los Angeles Co.: *Bacigalupi* 4818 (JEPS); *Baker* 5325 (UC), 20 May 1909, *Baker s.n.* (DS); *Ernst* 231 (UC); *Ferris & Rossbach* 9482 (LA); *Grant* 681 (PH), 682 (ARIZ); *Henrickson* 5527 (ASU); *Johnson* 3979 (LA two sheets); *Jones* 3373 (CAS); *Keil* 11891 (ASU); *Smith* 3597 (UARK); *Strother* 614 (UC); *Wiggins* 20590 (DS); *Wiggins & Ernst* 231 (UC); *Wolf* 8520 (ARIZ, DS, LA). Orange Co.: May 1899, *Bowman s.n.* (DS). Riverside Co.: *Apton* 171 (ASU); *Cooper* 1024 (ARIZ, LA); *Fosberg* S1706 (PH); *Hitchcock & Mublick* 23091 (DS); *Howell* 1232 (UC); *Raven* 11870 (JEPS); *Rose* 49061 (ARIZ, UC); *Spencer* 653 (PH); *Terrell* 71 (ASU); *Tilforth et al.* 1502 (UC). San Bernardino Co.: *Alexander & Kellogg* 2009 (in part UC); *Eastwood* 18661 (CAS); 11 May 1936, *Epling & Stewart s.n.* (LA); *Everett & Balls* 23073 (CAS); *Ferris & Bacigalupi* 13194 (DS); *Fosberg* S1684 (PH), S2815 (PH); *Gould* 904 (PH); 24 Apr 1937, *Grant s.n.* (LA); *Heller* 7674 (PH); *Holmgren & Holmgren* 7610 (ASU); *Jepson* 12634 (JEPS); *Kappler* 1102 (LA), 1613 (LA), 2048 (LA); *Keil* K12397 (ASU); 24 Feb 1935, *Krames s.n.* (JEPS); Apr 1878, *Lemmon s.n.* (JEPS); 24 Apr 1938, *Lewis s.n.* (LA); *Raven* 11896 (JEPS); *Shreve* 8172 (ARIZ two sheets); *Smith* 3576 (UARK); *Tilforth & Dourley* 362 (ASU); *Wiggins* 13375 (ARIZ, DS, UC); *Wolf* 6471 in part (ARIZ), 6505 (ARIZ, LA). San Diego Co.: *Abrams* 3628 (DS, PH); *Brandege* 3368 (DS); *Clements & Clements* 224 (PH two sheets), 225 (PH two sheets); *Glownke* 4661 (PH); *Jepson* 8529 (JEPS), 8677 (JEPS), 11819 (JEPS); 7 Feb 1884, *Orcutt s.n.* (PH); 4 Apr 1937?, *Rowntree s.n.* (CAS); *Smith* 3588 (UARK); *Spencer* 172 (PH). Tulare Co.: 29 Mar 1911, *Farr s.n.* (PH); 30 Mar 1937, *Winblad s.n.* (CAS). Ventura Co.: *Kappler* 283 (LA). County not specified: Apr 1905, *Brandege s.n.* (PH); *Parish & Parish* 620 (PH); May 1903, *Saunders s.n.* (PH), Apr-May 1906, *Saunders s.n.* (PH); May 1904, *Williamson s.n.* (PH two sheets). MEXICO. Baja California: *Carter et al.* 1049 (ARIZ); 15 Feb 1935, *Epling & Robison s.n.* (ARIZ, LA, UC); *Hall* 3973 (UC); *Lewis & Thompson* 12163 (UC); *Moran* 16871 (ARIZ), 20807 (UC); *Palmer* 677 (ARIZ, UC); *Raven et al.* 12561 (CAS, LA, UC); *Wiggins* 9792 (DS).

An annual commonly 10–30 cm tall, with leaves entirely basal, the outer phyllaries entire, small heads (mostly 1.5–3.5 cm in diameter), narrow ultimate leaf segments (about 1 mm or less in width) and achenes with corky wings and dull body with many tiny clavellate trichomes, on sandy and gravelly desert plains and washes of southern California from San Diego County north and west to Inyo, Tulare, and Ventura counties and of Baja California, Mexico.

This species was confused with *C. douglasii* for many years, and was first clearly distinguished from that species by Sharsmith (1938). *Coreopsis californica* was the subject of a recent paper (Smith, 1983) in which a new variety was named. While normally having epappose achenes, individuals of the species rarely exhibit achenes with two thin, antrorsely hispidulous aristae. Largely because of its narrow leaf segments, scapose habit, and its habitat (desert vs mountains), I consider *C. californica* to be the most advanced species of section *Euleptosyne*.

8b. *COREOPSIS CALIFORNICA* var. *NEWBERRYI* (A. Gray) E. B. Smith, *Brittonia* 35:168. 1983.

TYPE: U.S.A. ARIZONA: Sitgreaves [Sitgravis] Pass, Colorado [River], 26 Mar, *Dr. Newberry s.n.* (LECTOTYPE, here designated: GH!). This type was improperly called the holotype in my earlier paper (Smith, 1983).

Leptosyne newberryi A. Gray, Proc. Amer. Acad. Arts 7:358. 1868.

Additional specimens examined: U.S.A. ARIZONA. Gila Co.: 9 Mar 1940, *Nichol s.n.* (ARIZ); *Palmer 126* (GH), Apr 1932, *Palmer s.n.* (CAS). Graham Co.: *McGill LAM2341* (ASU); *Mcguire et al 19173* (ARIZ); *Smith 3596* (UARK). Maricopa Co.: 14 Mar 1937, *Darrow s.n.* (ARIZ). Mohave Co.: 15 Mar 1931, *Braem s.n.* (DS); *Peebles 11281* (ARIZ). Pinal Co.: *Gillespie 5420* (AS, DS, UC); *Haase et al. 712* (ARIZ); *Lehto 17970* (ASU); *Peebles et al. 858* (ARIZ), *5172* (ARIZ, LA two sheets); *Smith 3595* (UARK); *Sundell et al. 11725* (ASU).

A variety differing from the typical one in achene characters (see key), of gravelly floors of desert washes in southeastern Arizona (Gila, Maricopa, Pinal and Graham counties; also known from one local area in southern Mohave County).

This variety replaces the typical variety in Arizona (Smith, 1983). The varieties of *C. californica* show maternal inheritance of the achene spot pattern. Despite the larger achenes of var. *newberryi*, its peripheral range compared with other taxa in the section suggests that it is more recently derived than var. *californica*; it is probably the most advanced taxon in section *Euleptosyne*.

ACKNOWLEDGMENTS

My thanks to Dr. R. F. Thorne (RSA) for providing achenes of *C. gigantea* and *C. maritima*, and to the curators of the following herbaria, who loaned herbarium material or/and checked their herbaria for type material for this study: ARIZ, ASU, B, BM, C, CAS, DS, F, G, GH, JEPS, K, LA, MIN, MO, NEB, NY, PH, POM, PNH, RAS, UC, US. Enquiries to P and W produced no responses. This work was supported by NSF grant DEB80-11712.

REFERENCES

- CRAWFORD, D. J. and E. B. SMITH. 1980. Flavonoid chemistry of *Coreopsis grandiflora* (Compositae). *Brittonia* 32:154-159.
- and —. 1982a. Allozyme variation in *Coreopsis nuecesoides* and *C. nuecensis* (Compositae), a progenitor-derivative species pair. *Evolution* 36: 379-386.
- and —. 1982b. Allozyme divergence between *Coreopsis basalis* and *C. wrightii* (Compositae). *Syst. Bot.* 7:359-364.
- and —. 1983a. Leaf flavonoid chemistry of North American *Coreopsis*: Intra- and intersectional variation. *Bot. Gaz.* 144:577-583.
- and —. 1983b. The distribution of anthochlor floral pigments in North American *Coreopsis* (Compositae): Taxonomic and phyletic interpretations. *Amer. J. Bot.* 70:355-362.
- and —. 1984a. Allozyme divergence and intraspecific variation in *Coreopsis grandiflora* (Compositae). *Syst. Bot.* 9:219-225.
- and —. 1984b. Leaf flavonoid chemistry and the taxonomy of *Coreopsis*, sections *Pugiopappus* and *Euleptosyne* (Compositae). *Madroño* 31:1-7.

- , ———, and A. M. MUELLER. 1980. Leaf flavonoid chemistry of *Coreopsis* (Compositae) section *Palmatae*. *Brittonia* 32:452–463.
- SHARSMITH, H. K. 1938. The native Californian species of the genus *Coreopsis* L. *Mandroño* 4:209–231.
- SHERFF, E. E. 1936. Revision of the genus *Coreopsis*. *Field Mus. Nat. Hist., Bot. Ser.* 11:277–475.
- . 1955. *Coreopsis*. in: E. E. Sherff and E. J. Alexander, *Compositae-Heliantheae-Coreopsidinae*. *N. Amer. Fl. II.* 2:4–40.
- SMITH, E. B. 1972. Lobing of the disk flower corollas in North American *Coreopsis* (Compositae). *Brittonia* 24:87–89.
- . 1973. A biosystematic study of *Coreopsis saxicola* (Compositae). *Brittonia* 25:200–208.
- . 1974. *Coreopsis nuecensis* (Compositae) and a related new species from southern Texas. *Brittonia* 26:161–171.
- . 1975. The chromosome numbers of North American *Coreopsis*, with phyletic interpretations. *Bot. Gaz.* 136:78–86.
- . 1976. A biosystematic survey of *Coreopsis* in eastern United States and Canada. *Sida* 6:123–215.
- . 1982. Phyletic trends in section *Coreopsis* of the genus *Coreopsis* (Compositae). *Bot. Gaz.* 143:121–124.
- . 1983. A new variety of *Coreopsis californica* (Compositae) endemic to Arizona. *Brittonia* 35:164–169.
- and D. J. CRAWFORD. 1981. Comparative leaf flavonoid chemistry of *Coreopsis nuecensoides* and *C. nuecensis* (Compositae), a progenitor-derivative species pair. *Bull. Torrey Bot. Club* 108:7–12.
- SMITH, J. P. JR., R. J. COLE, and J. O. SAWYER JR. 1980. Inventory of rare and endangered vascular plants of California. *Spec. Pub. No. 1* (2nd ed.), Cal. Native Plant Soc., Berkeley.

ON THE HISTORY OF COASTAL PLAIN SPECIES ON THE CUMBERLAND PLATEAU AND HIGHLAND RIM

A. M. HARVILL, JR.

Longwood College, Farmville, VA 23901, U.S.A.

ABSTRACT

Distributional studies of the coastal plain species isolated on the Cumberland Plateau and Highland Rim indicate that they are southern species which migrated onto the plateaus in late Pleistocene from northern Alabama.

INTRODUCTION

Henry Svenson (1941) worked on the Cumberland Plateau and Highland Rim of Tennessee during the decade of the 1930s. Here he turned up many coastal plain species, and he points out that, "Though the Cumberland Plateau is separated from the Highland Rim by a wall of limestone and sandstone nearly a thousand feet high, the coastal plain element is much the same on both plateaus (p. 111). And later (p. 112), "The problem in its larger aspects has been admirably discussed (with many maps showing distribution of species) by Professor Braun and Professor Fernald."

During these years Professor Braun (1937) was finding many coastal plain species on the Cumberland Plateau of Kentucky, and both she and Professor Fernald (1937) contended that these are ancient species, originating in the Appalachian highlands, which have migrated out onto the coastal plain.

On this suggestion that isolated colonies of coastal plain species within the Appalachian highlands represent ancestral stocks, Lloyd Shinnars (1964, p. 260) wrote, "I think a more likely explanation is just the reverse: they are late emigrants *from* the Coastal Plain." And further (p. 261), "There have been shore lines and hence coastal plains, however small, for as long as sea and land have been differentiated. I see no reason to imagine that typical Coastal Plain plants ever had to exist anywhere else." Now, with the vast field data amassed during the last several decades, we can get a better picture of patterns of distribution and migration pathways of coastal plain species in southeastern North America.

THE COASTAL PLAIN ELEMENT

In his "*Notes on the Tennessee Flora*" Svenson designates the following thirteen species as coastal plain plants occurring on the Cumberland Plateau and/or the Highland Rim. They are all wetland plants and are all southern

species with the bulk of their populations south of the Mason-Dixon Line, a good biological as well as political line according to John K. Small (see Shinnars, 1962, p. 29).

Lycopodium alopecuroides
Erianthus strictus
Muhlenbergia torreyana
Rhynchospora perplexa
Xyris iridifolia
Juncus elliotii
Zigadenus densus

Iris prismatica
Polygonella americana
Hypericum nudiflorum
Ludwigia hirtella
Gaylussacia dumosa
Cynoctonum mitreola

Although only one sedge is listed above, *Rhynchospora perplexa*, studies of the overall distributions of the sedges which occur in Virginia show that no less than fifteen of our coastal species are now known from the plateau regions of Tennessee, and seven of these, marked with an asterisk, are found elsewhere mostly on or near the coastal plain.

Carex gigantea (Fig. 2)
 **C. glaucescens*
C. joori
Cyperus albomarginatus
 **C. haspan*
Eleocharis microcarpa
E. tuberculosa
Rhynchospora caduca

**R. chalarocephala*
R. corniculata
 **R. debilis*
 **R. filifolia*
R. gracilentia
 **R. perplexa*
 **R. rarifolia*

Five more of Virginia's coastal plain species occur in northern Alabama, and all of them are wetland plants, and they too are almost restricted to the coastal plain:

Cyperus filicinus
Eleocharis baldwinii (Fig. 1)
E. fallax

Rhynchospora inexpansa
Scirpus divaricatus

PATHWAYS TO THE PLATEAUS

Figures 1 and 2 suggest migration pathways of species which move inland when they extend westward beyond the piedmont. Going westward from the eastern seaboard, Alabama is the first state which offers relatively easy access to the plateaus of Tennessee, with almost continuous streams and wetlands favorable for the migrations of wetlands species. Thus, the key to the distributions of these isolated populations on the Cumberland Plateau and Highland Rim appears to be northern Alabama, for here there is an approach to a continuity of wetland habitats.

Fenneman (1938, p. 336) writes on northern Alabama: "The boundary between the [Cumberland] Plateau and the Gulf Coastal Plain has no marked features. In the margin of the former, hills may be capped by remnants of coastal plain sediments. In the margin of the latter streams cut down into the older rocks of the plateau. Between these two phases there is grad-

uation." And Harper (1937, p. 13) discussing the Cumberland Plateau: "... at its southwestern extremity (which is all in Alabama), the sandstone of the plateau dips gradually beneath the unconsolidated clay, and gravel of the coastal plain, and the boundary is very irregular or indefinite In Franklin County, for example around Spruce Pine and Phil Campbell, the coastal plain deposits attain an altitude of a little over 1,000 feet above sea level, which is the highest recorded elevation in the coastal plain in the eastern United States." Thus there is no sharp break between the piedmont and the coastal plain as in most of the region to the east of Alabama.

INVASIONS OF THE PLATEAUS

Quoting again from the Shinnars paper (1964, pp. 260-261): "We know from geological evidence that the close of the Pleistocene was a period of

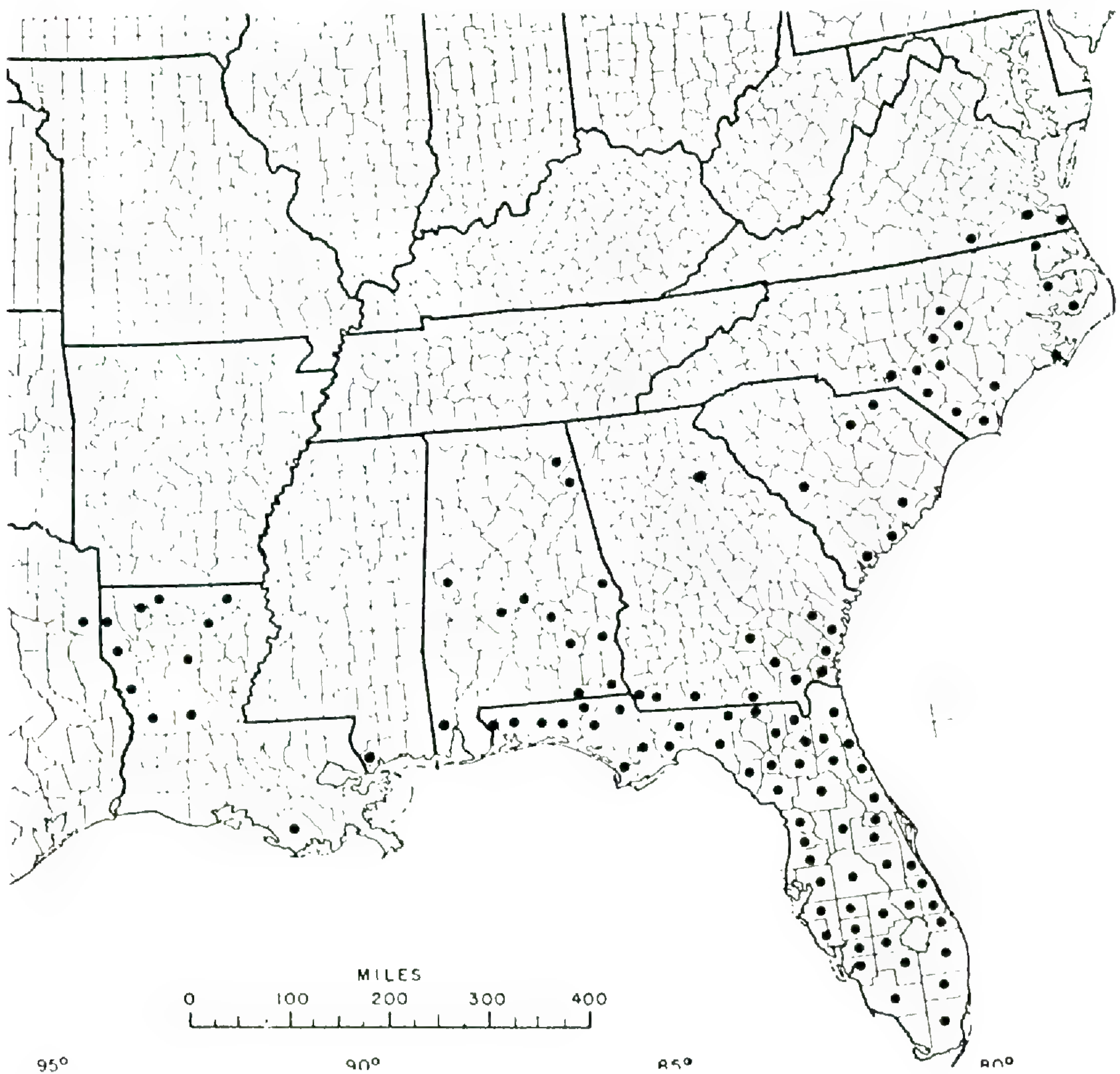


Figure 1. Distribution of *Eleocharis baldwinii* illustrating probable migration route to the plateaus.

vast flooding and erosion, with the development of flood plains and terraces outside the glaciated area. It seems to me highly probable that the predominantly weedy Coastal Plain species were rapid invaders, spreading far out of the Coastal Plain itself (the handful of Coastal Plain species about the western Great Lakes are well known illustrations), to be replaced more gradually in succession by the Appalachian flora."

Since this was written, the pluvial period from 24,000 to 10,000 years B. P. has gained further documentation (Flint, 1971), providing the cause of the flooding and erosion, as well as the wetlands and disturbed areas favorable for rapid invasions. Moreover, the earliest expansion of deciduous forest from full-glacial refuges has been recorded at 16,500 years B. P. (Delcourt and Delcourt, 1979). Thus, the coastal plain species must have moved onto the Cumberland Plateau and Highland Rim in late Pleistocene

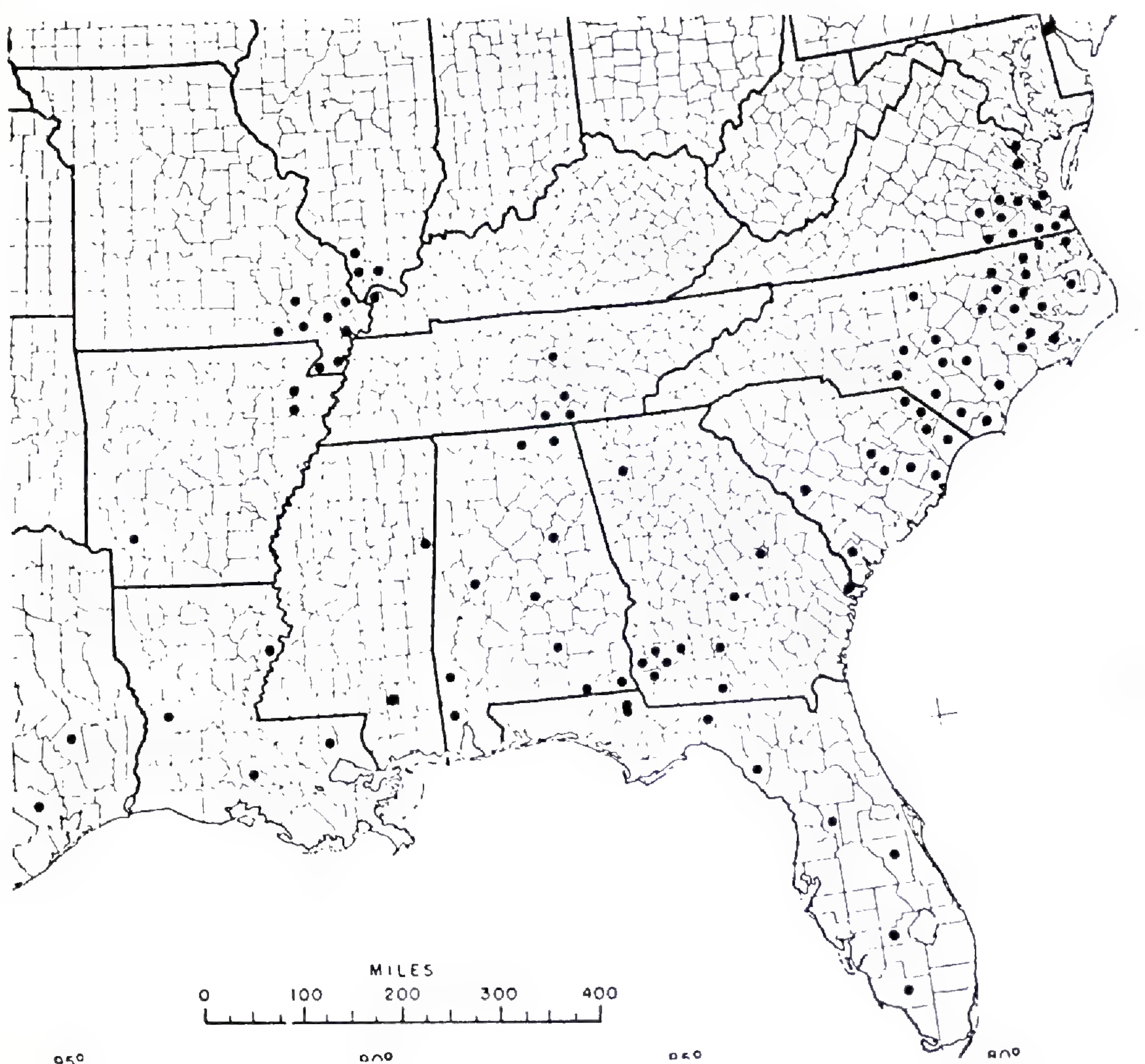


Figure 2. Distribution of *Carex gigantea*.

as Shinnars suggested. Their replacement in succession, in all but the most favorable habitats, was undoubtedly speeded up by the *xerothermic* period from about 8,000 to 5,000 B. P., thereby making the coastal plain—mountains disjunctions which have long been famous.

EPILOGUE

In the heyday of explorations in our region by Braun, Fernald and Svenson, the distributional data available to them were not nearly enough to provide a basis for sound phytogeographic conclusions. This paucity of data is now being rectified by the activity of many able field botanists throughout the southland, and with important advances in palynology, we are getting the foundations to eventually understand many of the distributional anomalies.

ACKNOWLEDGMENTS

This work was made possible by the generosity of many botanists, especially Jerry Baskin, David Boufford, Nancy Coile, Robert Haynes, James Kessler, Robert Kral, Jimmy Massey, Kent Perkins, John Thieret, Dale Thomas, Wayt Thomas, Ronald Tryl and Eugene Wofford. I extend my appreciation to all of them.

REFERENCES

- BRAUN, E. L. 1937. Some relationships of the flora of the Cumberland Plateau and Cumberland Mountains of Kentucky. *Rhodora* 39:193–208.
- DELCOURT, P. A. and H. R. DELCOURT. 1979. Late Pleistocene and Holocene distributional history of the deciduous forest in the southeastern U. S. *Veröff. Geobot. Inst. ETH, Stiftung Rübel, Zürich* 68:79–107.
- FENNEMAN, N. M. 1938. *Physiography of Eastern United States*. McGraw-Hill, New York.
- FERNALD, M. L. 1937. Local plants of the inner coastal plain of southeastern Virginia. *Rhodora* 39:465–489.
- FLINT, R. F. 1971. *Glacial and Quaternary Geology*. John Wiley & Sons, New York.
- HARPER, R. M. 1937. A depressed outlier of the Cumberland Plateau in Alabama and its vegetation. *Castanea* 2:13–18.
- SHINNERS, LLOYD H. 1962. Evolution of the Gray's and Small's manual ranges. *Sida* 1:1–31.
- _____. 1964. How to study the Florida flora. *Sida* 1:257–261.
- SVENSON, H. K. 1941. Notes on the Tennessee flora. *J. Tennessee Acad. Sci.* 16:111–160.

NOTEWORTHY PLANTS FROM NORTH FLORIDA

LORAN C. ANDERSON

*Department of Biological Science, Florida State University,
Tallahassee, FL 32306, U.S.A.*

ABSTRACT

A guide to the vascular plants of the Florida panhandle is to be published next year. Over 30 additions to that guide are documented here. The following appear to be first reports for the state of Florida: *Arabis canadensis*, *Asclepias, viridiflora*, *Bromus tectorum*, *Cayaponia grandiflora*, *Helianthus atrorubens*, *Scutellaria drummondii*, and *Solidago flaccidifolia*.

Production of "A Flora of Florida" by cooperative effort is underway. Contributions to support such a flora include those of Long and Lakela (1976) and Wunderlin (1983). Now Clewell's guide to the vascular plants of the Florida panhandle is to be published in the spring of 1985. The area of coverage is from Madison, Lafayette, and Dixie counties west to the Alabama state line.

Clewell has been apprised of new discoveries during the preparation of his guide, and he has included them, but additional taxa were found after his work was sent to the publisher. So, new taxa and significant range extensions are noted here to update Clewell's guide. Since pre-publication drafts were not available to me, I may have included a few species that were incorporated in his work, but certainly the bulk of what is reported is new to the panhandle. Voucher specimens are at FSU.

ARABIS CANADENSIS L. Jackson Co.: Chipola River, E of Bumpnose Rd, S. W. Leonard 7843. Liberty Co.: S of Alum Bluff, S. W. Leonard 7692, W of Sweetwater, S. W. Leonard 7738 (new to Florida).

ASCLEPIAS VIRIDIFLORA Raf. Gadsden Co.: NW of Chattahoochee, A. R. Gholson 10499 (new to Florida).

ASTER FONTINALIS Alexander in Small. Taylor Co.: vic. Keaton's Beach, R. K. Godfrey 61655, 81068.

ASTER PHYLLOLEPIS T. & G. Gadsden Co.: River Junction, R. K. Godfrey 80045 (this confirms Kral's earlier collection, see *Rhodora* 83:312, 1981).

ASTER SHORTII Lindl. in Hook. Gadsden Co.: Apalachicola River bluffs near Dolan Rd, R. K. Godfrey 80086, 80285, 81044, S. W. Leonard 7794.

ASTER SIMPLEX Willd. Franklin Co.: Apalachicola, L. C. Anderson 6722. Jackson Co.: E of Sneads, R. K. Godfrey 80222. Leon Co.: Tallahassee, L. C. Anderson 4097, 4965.

BOTRYCHIUM JENMANNII Underw. (= *B. alabamense* Maxon, see Taxon

32:57, 1983). Gadsden Co.: E of Chattahoochee, *A. K. Gholson* 10658.

BROMUS TECTORUM L. Leon Co.: NW edge Tallahassee, *L. C. Anderson* 6375 (new to Florida).

CAYAPONIA GRANDIFLORA (T. & G.) Gray. Jackson Co.: Apalachicola River, E of Sneads, *R. K. Godfrey* 78973. Liberty Co.: Torreya State Park, *R. K. Godfrey* 79101 (new to Florida).

CENTAUREA CYANUS L. Leon Co.: Tallahassee, *L. C. Anderson* 6314.

CHIOCOCCA ALBA (L.) Hitchc. Dixie Co.: Shired Island, *S. W. Leonard* 8099.

COREOPSIS PUBESCENS Ell. var. *ROBUSTA* Gray ex Eames. Lafayette Co.: N edge of Mayo, *R. K. Godfrey* 80837 (range extension eastward from Walton Co.).

CYNANCHUM SCOPARIUM Nutt. Franklin Co.: St. Vincent Island, *L. C. Anderson* 6558.

DESMODIUM CANESCENS (L.) DC. Taylor Co.: E of Aucilla River, S of rte 98, *R. K. Godfrey* 79112.

DIONAEA MUSCIPULA Ellis. Franklin Co.: *L. C. Anderson* 4447, *R. K. Godfrey* 75838. Apparently planted, but naturalized and spreading. It was first observed in 1977; over 120 flowering scapes were seen in 1981.

ERIOCAULON LINEARE Small var. *GIGAS* Moldenke. Leon Co.: Clear Lake, *R. K. Godfrey* 75349; Santa Rosa Co.: Blackwater River near Milton, *R. K. Godfrey* 75477. Previously known only from type collection at mouth of Yellow River in Santa Rosa Co., see *Phytologia* 27:444, 1974.

FORESTIERA SEGREGATA (Jacq.) Krug & Urban. Dixie Co.: Shired Island, *S. W. Leonard* 8098.

HELIANTHUS ATRORUBENS L. Jackson Co.: Three Rivers State Park, *A. K. Gholson* 7375 (new to Florida).

IPOMOEA HEDERACEA (L.) Jacq. var. *INTEGRUSCULA* Gray. Madison Co.: SE of Madison, *L. C. Anderson* 6516.

LACTUCA SERRIOLA L. Columbia Co.: W of High Springs, *R. K. Godfrey* 80458 (this area just E of panhandle area, but also collected by Burkhalter in Escambia Co.).

MYRSINE GUIANENSIS (Aubl.) Kuntze. Dixie Co.: rte 349 in Suwannee, *S. W. Leonard* 8090.

OROBANCHE UNIFLORA L. Leon Co.: between Chaires and Capitola, *R. K. Godfrey* 80463.

PANICUM RAMOSUM L. Franklin Co.: Carrabelle Beach, *L. C. Anderson* 6639. Gadsden Co.: rte 267 S of Quincy, *L. C. Anderson* 6420. Madison Co.: 3 mi W of Madison, *T. Bone* 62. Planted for roadside stabilization and rapidly spreading.

PARIETERIA FLORIDANA Nutt. Leon Co.: Tallahassee, *J. B. Nelson* 1494.

PASSIFLORA SUBEROSA L. Dixie Co.: Shired Island, *S. W. Leonard* 8100.

PECTIS PROSTRATA Cav. Gadsden Co.: just SE of I-10 bridge over Apalachicola River, *L. C. Anderson* 4573.

PHLOX GLABERRIMA L. Bay Co.: rte 79 N of Ebro, R. K. Godfrey 80825; Jackson Co., Bumpnose Rd N of Marianna, A. K. Gholson 10599.

PYRACANTHA KOIDZUMII (Hayata) Rehder. Escambia Co.: Pensacola, R. K. Godfrey 80739; Gadsden Co.: S of Chattahoochee, J. B. Nelson 2740. Jackson Co.: Mariana, R. K. Godfrey 80511. Wakulla Co.: St. Marks, R. K. Godfrey 80777.

ROSA BRACTEATA Wendl. Leon Co.: E of Tallahassee, R. K. Godfrey 80698.

SALVINIA MINIMA Baker. Jackson Co.: Lake Seminole, A. K. Gholson 10657. Leon Co.: Lake Talquin, R. K. Godfrey 77112.

SCUTELLARIA DRUMMONDII Benth. Columbia Co.: W of High Springs, A. K. Gholson in 1982, R. K. Godfrey 80459 (just E of panhandle area but apparently new to Florida).

SESBANIA VIRGATA Poir. Escambia Co.: Pensacola, R. K. Godfrey 80740; Gulf Co., NW of Port St. Joe, J. Beckner 1851.

SOLIDAGO FLACCIDIFOLIA Small. Jackson Co.: Three Rivers State Park, A. K. Gholson 10193, R. K. Godfrey 80218. Liberty Co.: Torreya State Park, L. C. Anderson 4107 (new to Florida).

VICIA GRANDIFLORA Scop. Gadsden Co.: SE of Quincy, R. K. Godfrey 77534.

VIOLA CUCULLATA Ait. Jefferson Co.: Lamont, R. Kral 6333. Liberty Co.: Torreya State Park, R. K. Godfrey 71314.

Recent annotations of *Viola* by H. E. Ballard show FSU has many specimens from north Florida of *V. palmata* L., *V. pedatifida* G. Don, and *V. sagittata* Ait. The specimens were originally identified as either *V. esculenta* or *V. septemloba*.

REFERENCES

- CLEWELL, A. F. 1985. Guide to the vascular plants of the Florida Panhandle. Florida State University Press/Univ. Presses of Florida, Tallahassee.
 LONG, R. W., and O. LAKELA. 1976. A flora of tropical Florida. Banyan Books, Miami.
 WUNDERLIN, R. P. 1983. Guide to the vascular plants of Central Florida. Univ. of Florida Presses, Tampa.

TAXONOMIC NOTES ON TWO COMMON NEOTROPICAL SPECIES OF *CYPERUS* (CYPERACEAE)

GORDON C. TUCKER

*Department of Botany, Duke University
Durham, NC 27706, U.S.A.*

ABSTRACT

The results of a herbarium study of two common species of *Cyperus* (*C. manimae* and *C. odoratus*) are presented. It is shown that: 1) in *C. manimae*, the varieties *asperrimus*, *divergens* and *phaeocephalus* do not merit recognition; 2) *C. spectabilis* Link and *C. apiculatus* Liebm. should be treated as synonyms of *C. manimae*; and 3) *C. macrocephalus* Liebm., *C. eggersii* Boeck., *C. acicularis* (Schrad.) Steud. and *C. engelmannii* Steud. are synonyms of *C. odoratus* L.

INTRODUCTION

In the course of an investigation of the Mexican and Central American species of *Cyperus*, the taxonomic status of two species, *C. manimae* and *C. odoratus*, has been altered. Since these are two of the commonest species of the region, it seems desirable to publish these findings in advance of completion of the study. The present study has been based on some 13,000 herbarium specimens from 33 herbaria. About 90% of these specimens were collected in Mexico and Central America, the remainder in North America, South America and the Old World.

I. The status of *C. manimae*, *C. spectabilis* and *C. apiculatus* (Subgenus *Cyperus*).

Cyperus manimae is one of the most common species of *Cyperus* in the mountains of Mexico, particularly in the pine and oak forests from about 2000–2700 m elevation. The species ranges from the southwestern United States through Central America to Venezuela and Peru. Both Kükenthal (1935-36) and Ayers (1946) also recognized *C. spectabilis*, which was distinguished only by its lax spikes usually borne on rays; typical *C. manimae* was described as having dense spikes and often lacking rays. According to Kükenthal the range of *C. spectabilis* was nearly the same as that of *C. manimae*.

In the present study, numerous specimens with sessile spikes were observed, as well as collections in which the rays were as much as 16 cm long (see Fig. 1). The length of the rays was not significantly correlated with the height of the culm. Thus, *C. spectabilis* could not be distinguished

based on sessile versus pedunculate spikes. Several other species, *e.g.* *C. luzulae* (L.) Retz. (Denton, 1978) and *C. haspan* L. (Tucker, 1983) similarly have both sessile and pedunculate forms.

The second problem in distinguishing *C. spectabilis* and *C. manimae* lay in the lack of a clearcut difference between dense and lax spikes. About one-quarter of the collections examined was clearly intermediate with respect to the density of the spikelets on the rachis of the spikes. Some 100 typical examples of *C. manimae* and *C. spectabilis* were studied critically with the hope of finding other characters that might be correlated with the density of the spikes. Achene length and width, scale length, width and color, mucro length, culm roughness and ray length were investigated. None showed positive correlation with the density of the spokes. Thus, it is concluded that the populations previously classified as *C. spectabilis* merely represent a portion of the range of variability of *C. manimae* in one character. Thus, *C. spectabilis* is here considered to be a synonym of *C. manimae*.

Both Kükenthal (1935-36) and Ayers (1946) recognized the Mexican species *C. apiculatus* Liebm. Ayers distinguished *C. apiculatus* from *C. manimae* by the former species having: fewer inflorescence bracts, wider scales, and longer, iridescent achenes. He cited ten collections of *C. apiculatus*, eight of which were seen in the present study: Mexico. Distrito Federal: Bourgeau 432 (GH); Guerrero: Manchón, Hinton 9244 (K, LL, MICH); Jalisco: Guadalajara, Pringle 3844 (K, LL, MSC); Huejotitán, Diguét *s.n.*, Oct. 1912 (K); Michoacán: vic. Morelia, Arsène 2692a (GH), 5579 (NY), 5751 (MO), and 5844 (GH, MO). On the basis of these collections, it could not be shown that *C. apiculatus* differed from *C. manimae* in any of the characters listed by Ayers. For the above specimens, the average number of inflorescence bracts per plant was 3; the average for *C. manimae* (based on examination of some 400 collections from throughout its range) was 4. For scales, the average measurements were 2.2 mm long and 1.6 mm wide for *C. apiculatus*, versus 2.1 mm long and 1.8 mm wide for *C. manimae*; and for achenes 1.5 mm long and 0.8 mm wide, versus 1.6 mm long and 0.8 mm wide.

Several collections cited by Ayers (for example, Pringle 3844) had glossy achenes. Ayers used the word "iridescent", which is inappropriate. Kükenthal (1935-36) used the term "nitida" to describe the achenes of both *C. manimae* and *C. apiculatus*. This is accurate, although both dull and glossy achenes were observed in *C. manimae*.

To summarize, the present author found no evidence to support the recognition of *C. apiculatus*. None of the differences used by Ayers could be confirmed when a sufficiently large sample of *C. manimae* was examined, nor could any other consistent differences be detected. Thus, *C. apiculatus* is synonymized with *C. manimae* in this treatment.

Kükenthal recognized four varieties in both *C. manimae* and *C. spectabilis*. Ayers did not recognize any of Kükenthal's varieties of *C. spectabilis*. He

did recognize those in *C. manimae*, stating that there was "bewildering" intergradation between the varieties of *C. manimae*, particularly between the red and brown scaled varieties. Typical *C. manimae* has smooth culms, and blunt, brown scales. According to Ayers, the varieties are distinguished as follows: var. *asperrimus*, culms rough; var. *divergens*, scales mucronate; and var. *phaeocephalus*, scales red (see table I).

None of these varieties possessing supposedly distinguishing features has a distinct range—all occur more or less throughout the range of the species. In addition, some plants are found to exhibit the distinguishing features of more than one variety. For example, *Sharp and Gilly 156* (MSC) from Distrito Federal, and *Standley 61276* and *61277* (F), from Escuintla, Guatemala, both have rough culms and red scales. Similarly, *Pennell 18869* (GH, PH) from Chihuahua, Mexico, and *Williams et al. 22163* (F, NY) from

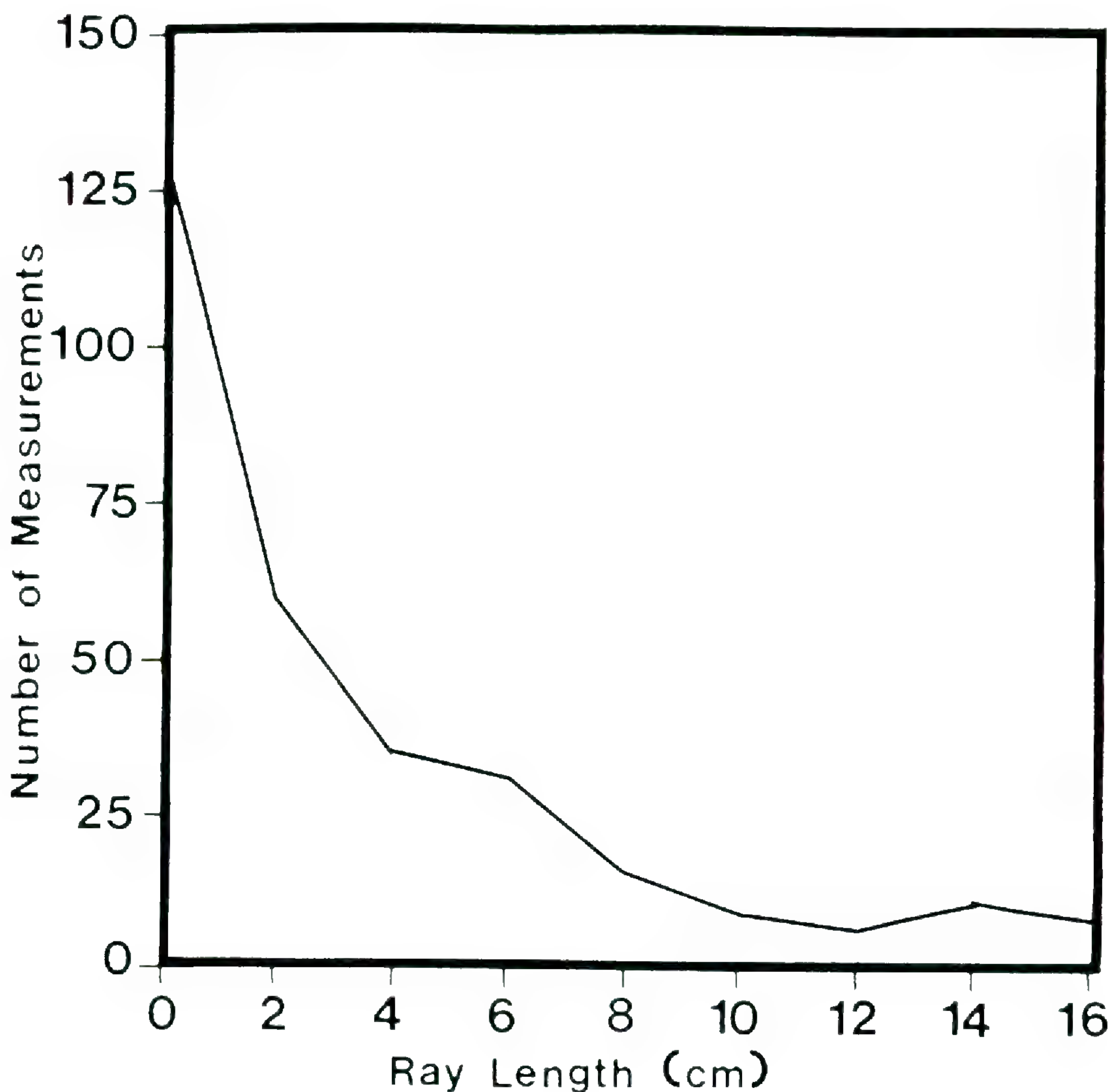


Fig. I. Frequency distribution of ray lengths in *Cyperus manimae*, including those plants treated by Kükenthal (1935-36) and Ayers (1946) as *C. spectabilis*.

Huehuetenango, Guatemala have scales that are red and mucronate.

Ayers did not state the mucro length of the scales of *C. manimae* var. *divergens*. From examination of cited specimens, he apparently had in mind plants with mucros longer than 0.3 mm. The length of mucros in collections studied show a continuous distribution from less than 0.1 mm to about 0.7 mm (see Fig. II.) Thus, a division between blunt and mucronate varieties would be arbitrary. Similar intergradation between red and brown scaled forms was observed. The most distinctive of the named varieties of *C.*

Table I. Comparison of the distinguishing features of the four varieties of *C. manimae* H.B.K. as recognized by Ayers (1946).

VARIETY	CULMS	SCALE APEX	SCALE COLOR
<i>manimae</i>	smooth	blunt	brown
<i>asperrimus</i>	hirtellate or scabrous	blunt	brown
<i>divergens</i>	smooth	conspicuously mucronate	brown
<i>phaeocephalus</i>	smooth	blunt	deep red

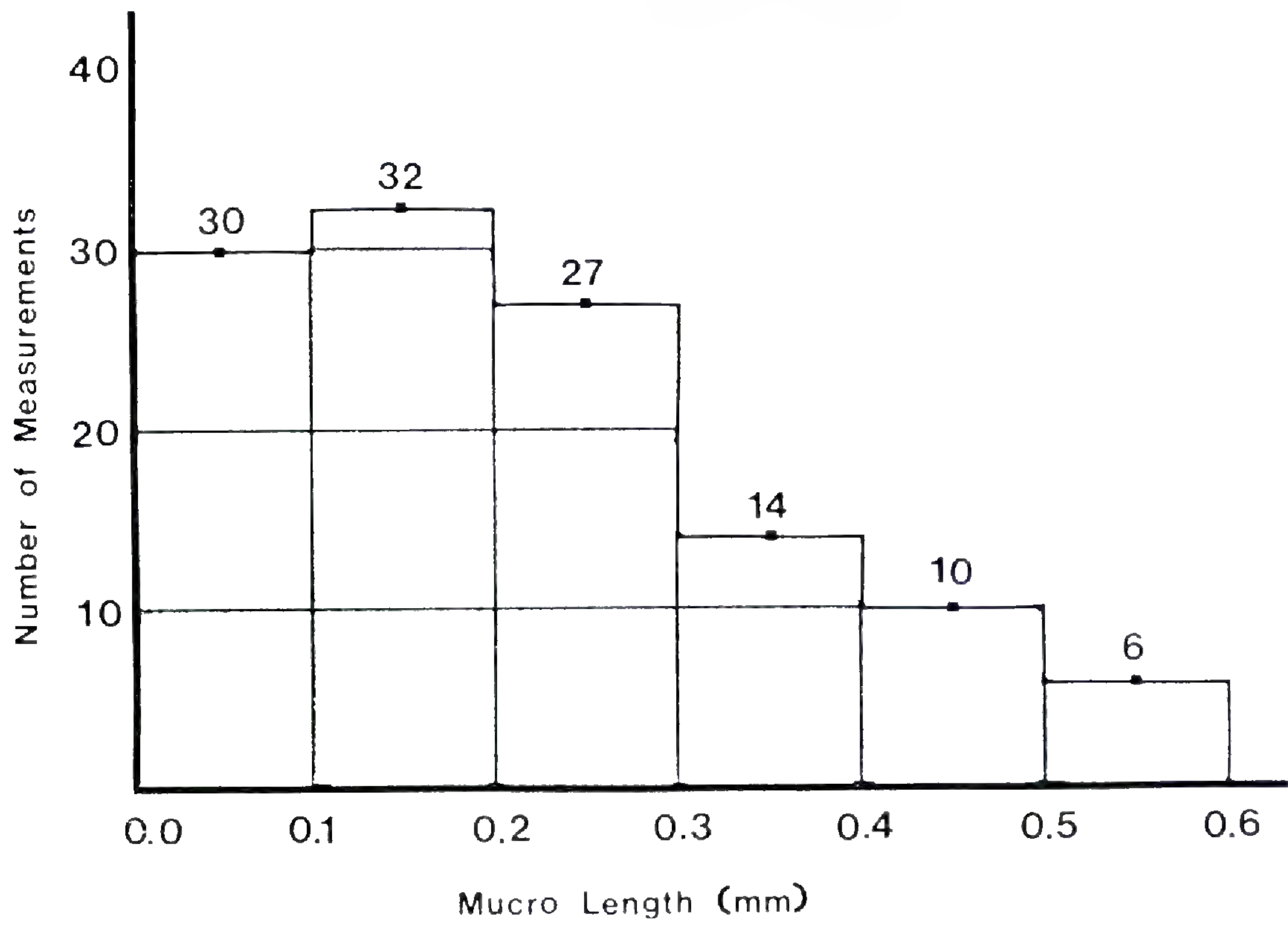


Fig. II. Frequency distribution of mucro lengths in *Cyperus manimae*.

manimae was var. *asperrimus*. Nearly all plants of *C. manimae* have either culms that are densely scabrous in the upper half (var. *asperrimus*) or entirely smooth (remaining varieties). However, in several collections, the culms were rough only in the uppermost 1–2 cm, thus providing an intermediate state between var. *asperrimus* and the typical variety.

To summarize, each of these three characters (culm surface, scale apex, and scale color) used by Ayers and by Kükenthal to distinguish the three varieties of *C. manimae*, exhibits considerable intergradation between the condition ascribed to typical *C. manimae* and that of the particular named variety. None of these character states has a discrete geographic range. Thus, it is appropriate to treat these three varieties as synonyms of *C. manimae*. The synonymy of *C. manimae* is given below.

CYPERUS MANIMAE H.B.K.

- C. manimae* Kunth in H.B.K., Nov. gen. sp. 1:209. 1816. TYPE: VENEZUELA. Orinoco River at Atabapo, *Humboldt & Bonpland* (HOLOTYPE: P). *Mariscus manimae* (H.B.K.) C. B. Clarke, Contr. U. S. Natl. Herb. 10:452. 1908.
- C. divergens* Kunth in H.B.K., Nov. gen. sp. 1:208. 1816. TYPE: MEXICO. Jorullo, *Humboldt & Bonpland* (HOLOTYPE: P). *C. manimae* var. *divergens* (H.B.K.) Kükenth., *Pflanzenreich* 4(20):463. 1936.
- *C. spectabilis* Link, Hort. Berol. 1:318. 1827. TYPE: not located.
- *C. triceps* Nees, *Linnaea* 19:697. 1847. TYPE: MEXICO. *Aschenborn* 121 (HOLOTYPE: not located; ISOTYPE: B!).
- *C. scaberrimus* Nees, *Linnaea* 19:697. 1847. TYPE: MEXICO. *Aschenborn* 123 (HOLOTYPE: not located; ISOTYPE: B!). *C. spectabilis* var. *scaberrimus* (Nees) Boeck., *Linnaea* 35:606. 1868.
- C. apiculatus* Liebm., *Mexic. halvgr.* 32. 1850. TYPE: MEXICO. Puebla, San Antonio Huatusco, Aug 1841, *Liebmann* 14352 (HOLOTYPE: C!).
- C. asperrimus* Liebm., *Mexic. halvgr.* 30. 1850. TYPE: MEXICO. Consoquitla, Aug 1841, *Liebmann* 14416 (HOLOTYPE: C!; ISOTYPE: HAL!). *C. manimae* var. *asperrimus* (Liebm.) Kükenth., *Pflanzenreich* 4(20):463. 1936.
- C. asperrimus* var. *multiflorus* Liebm., *Mexic. halvgr.* 31. 1850. TYPE: MEXICO. Mirador, *Liebmann* 14415 (HOLOTYPE: C!; ISOTYPE: K!).
- C. spectabilis* var. *multiflorus* Boeck., *Linnaea* 35:607. 1868. TYPE: MEXICO. *Schmitz* 808 (not located).
- C. phaeocephalus* Griseb., *Abh. Goett. Ges. Wiss.* 19:216. 1874. TYPE: not located. *Mariscus phaeocephalus* (Griseb.) C. B. Clarke, *Kew Bull. Addit. Ser.* 8:16. 1908. *C. manimae* var. *phaeocephalus* (Griseb.) O'Neill & Benedict, *Leaf. W. Bot.* 4:36. 1944.
- C. buckleyi* Britton, *Bull. Torrey Bot. Club* 13:207. 1886. TYPE: U. S. A. Texas, *Buckley s.n.* (LECTOTYPE: NY!; ISOLECTOTYPE: GH!). [Britton cited three collections, but did not specify a type. Buckley's collection has been annotated "type" in Britton's hand. Thus it is the lectotype.]
- C. parryi* Britton ex C. B. Clarke, *Kew Bull. Addit. Ser.* 8:9. 1908. TYPE: MEXICO. San Luis Potosí, *Parry & Palmer* 906 (LECTOTYPE, here designated: NY!; ISOLECTOTYPES: GH! US!). *C. spectabilis* var. *parryi* (C. B. Clarke) Kükenth., *Pflanzenreich* 4(20):462. 1936.
- C. manimae* var. *pseudospectabilis* Kükenth., *Pflanzenreich* 4(20):463. 1936. TYPE: MEXICO. Puebla, Chinantla, *Liebmann* 14460 (LECTOTYPE, here designated: C!).

II. *Cyperus odoratus* and segregate species (Subgenus *Torulinium* (Desv.) Kükenth.)

This pantropical and warm temperate species is exceedingly variable. Numerous segregates have been named. Various authors have treated these as species, varieties or synonyms of *C. odoratus*. These varied opinions were probably the result of a small number of collections seen by any one worker. In the present study, some 800 sheets of *C. odoratus* were examined, from Mexico and Central America, as well as a smaller number from North America, the West Indies and South America.

O'Neill (1940) in his treatment of the sedges of the Yucatan Peninsula recognized five species in Subgenus *Torulinium*. Ayers (1946) followed O'Neill's taxonomic concepts in his treatment of the genus in Mexico. O'Neill distinguished these five species as follows.

Achene linear, 1.5–2.0 mm long, 0.3 mm wide; scales usually distant, the apex of one not reaching the base of the next on the same side of the rachilla; wings of the rachilla linear, 1.2 mm long, 0.2 mm wide, reaching to top of the achene.

Leaves and bracts membranous, 1–4 (rarely 6) mm wide; culms 1–2 mm thick at the base *C. engelmannii* Steud.

Leaves and bracts coriaceous, 8–16 mm wide; culms 5–10 mm thick at the base..... *C. acicularis* (Nees) Steud.

Achene oblong to obovoid; scales imbricated on the same side of the rachilla; wings of rachilla elliptic, frequently not extending beyond the middle of the achene, 1.0 mm long, 0.4–0.5 mm wide.

Inflorescence congested into a single globose compact head 2–3 cm in diameter; the spikes sessile; achene ellipsoid; culms sharply triquetrous; leaves 4–6 mm wide..... *C. macrocephalus* Liebm.

Inflorescence with some rays; some of the spikes penducled; achenes obovoid-oblong to linear-oblong.

Spikelets suberect, penicillate, very densely fascicled at the ends of the rays *C. eggersii* Boeck.

Spikelets divaricate, subdense, scattered along the rachis..... *C. odoratus* L.

Kükenthal (1935–36) recognized *C. eggersii* and *C. macrocephalus* as distinct species, while treating *C. acicularis* and *C. engelmannii* as a variety and subspecies, respectively, of *C. odoratus*. Koyama (1978) reduced *C. acicularis* to the synonymy of *C. odoratus*. Correll and Johnston (1970) recognized *C. macrocephalus* as a species, but stated that it intergraded through the "form" *C. eggersii* to *C. odoratus*.

According to O'Neill's key, *C. engelmannii* and *C. acicularis* both have narrower achenes than the other three species. However, in the present study, no plants were observed with achenes less than 0.5 mm wide. Thus, none of the specimens studied would key out to *C. acicularis* or *C. engelmannii*, by O'Neill's criteria. Mature achenes were ellipsoid to oblong, but no linear achenes were noted, thus bringing O'Neill's distinction between these species into question. In the above key, these two species also differ from the others in having scales distant on the rachilla, i.e. the apex of a

scale not reaching the base of the scale above it. It was earlier shown (Tucker, 1983) that in southern Central America, *C. acicularis* could not be distinguished from *C. odoratus* on the basis of the overlap of the scales. The same situation has been noted in the Mexican and northern Central American material of *C. odoratus*.

A comparison of specimens annotated by O'Neill as *C. engelmannii* and *C. odoratus* revealed a continuous range in the amount of overlap or separation of successive scales on the same side of the rachilla. In some plants determined as *C. engelmannii*, successive scales are separated by as much as 0.6–1.0 mm; in others, the separation was less, 0.2–0.6 mm; still other plants are noted in which the scales overlap by approximately 0.2 mm and yet are separated by as great a distance on different spikelets at a comparable state of maturity on the same plant.

Ayers (1946, p. 55) stated that:

"In most of the United States, *C. engelmannii* is a very distinct entity. In Yucatan it is less distinct and in Brazil the line between *C. odoratus* and *C. engelmannii* is still more difficult to draw."

The taxonomy of *C. engelmannii* and *C. odoratus* in the United States has not been investigated in this present regional study. Voss (1972) noted that, in Michigan, *C. engelmannii* suggested an abnormal form of *C. odoratus*. Fernald (1950) recognized *C. odoratus* and *C. engelmannii*, although the number of collections of these species from the U. S. at the Gray Herbarium make it evident that he did not see a large sample. The infraspecific variation of *C. odoratus* in the U. S. is probably much the same as that observed in Mexican collections. The large number of specimens from Mexico and all of Central America examined in the present study, as well as a previous study (Tucker, 1983), has not revealed a single character separating *C. engelmannii* from *C. odoratus*.

Ayers (1946, p. 55) noted that *C. macrocephalus* ". . . is quite distinct along the Rio Grande, but further south forms intermediate between it and *C. eggersii* occur." Correll and Johnston (1970) stated that *C. macrocephalus* appeared to intergrade through the "form" *C. eggersii* into *C. odoratus*. A critical analysis of specimens annotated by O'Neill, plus numerous more recent collections, revealed the following quantitative characters that differed between these three taxa (see Table II). No further differences could be found between these three taxa, although numerous other characters, particularly those in O'Neill's key, were checked. On the average, *C. eggersii* and *C. macrocephalus* have shorter scales, shorter anthers and shorter achenes than *C. odoratus*. However, there is an overlap in the ranges of each character, and none exhibits a discontinuous distribution between any pair of species. While there is no single difference that consistently separates either *C. eggersii* or *C. macrocephalus* from *C. odoratus*, there is a partial correla-

Table II. Summary of examination of the characters used by O'Neill (1940) to distinguish *C. odoratus*, *C. eggersii* and *C. macrocephalus*. The values given are means and standard deviations. Sample sizes: *C. odoratus*, 255 collections; *C. eggersii*, 44; *C. macrocephalus*, 40. An average of five measurements of each character was made on each specimen.

	C. ODORATUS	C. EGGERSII	C. MACROCEPHALUS
Scale length (mm)	2.4 ± 0.4	2.0 ± 0.4	2.1 ± 0.2
Anther length (mm)	0.5 ± 0.1	0.3 ± 0.1	0.25 ± 0.1
Achene length (mm)	1.4 ± 0.2	1.2 ± 0.1	1.2 ± 0.1

tion of denser inflorescences with shorter scales, anthers and achenes. This might be indicative of some sort of genetic linkage of these characters, or a similar response of these parts of the plants to a certain environmental condition.

The absence of morphological discontinuity between *C. odoratus* and *C. eggersii* and *C. macrocephalus* in the three above characters and the observed intergradation of inflorescence forms among these three taxa, provide evidence that *C. macrocephalus* and *C. eggersii* are conspecific with *C. odoratus*. Several other New World species of Mexican *Cyperus* also have forms with dense rayless inflorescences, e.g. *C. luzulae* and *C. manimae*, an observation noted by Correll and Johnston (1970) as well.

Kükenthal (1935–36) treated *C. hayesii* (C. B. Clarke) Standley as a variety of *C. odoratus*. A previous study (Tucker, 1983) showed this to be a well marked species of the Pacific coast of Central America; *C. hayesii* is closely related to *C. correllii* (Koyama) Tucker¹ of the Bahama Islands. Thus *C. hayesii* is properly removed from the synonymy of *C. odoratus*.

Kükenthal (1935–36) included *C. purpureo-vaginatus* Boeck. as a synonym of *C. odoratus*. Examination of the type from Warming's herbarium (C), shows that the plant is really *C. distans* L.f. The continuous rachilla, the secondary rays and deciduous scales clearly indicate that it is a member of the subgenus *Cyperus*. Thus, the name *C. purpureo-vaginatus* is properly removed from the synonymy of *C. odoratus*, and belongs with *C. distans*.

The type of *C. odoratus* is Sloane's plate in his work on the natural history of Jamaica (Exell, 1944). This is the only reference given by Linnaeus, who did not see Sloane's specimen from which the plate was prepared, until after the publication of the first edition of *Species Plantarum* (Linnaeus, 1753). Sloane's plate is finely detailed and clearly it is this species. No other Jamaican species of the genus has such conspicuous secondary bracts and such a large inflorescence as *C. odoratus*.

¹CYPERUS CORRELLII (T. Koyama) Tucker, comb. nov., based on *Torulinium correllii* T. Koyama, Brittonia 28:252. 1976.

Cyperus odoratus, as recognized here, is readily recognized by its cylindrical spikelets in which the corky rachilla of the mature spikelet disarticulates at the base of each scale. Thus the mature spikelet breaks up into segments each consisting of a scale and an internode of the rachilla clasping the achene with its corky wings. Following is the synonymy of *C. odoratus* in Mexico and Central America.

CYPERUS ODORATUS L.

- C. odoratus* L., Sp. Pl. 1:46. 1753. TYPE: Sloane's plate in Voy. Jam. Nat. Hist. 1:116. t. 74, fig. 1, 1707 (see Exell, 1944). *Torulinium odoratum* (L.) Hooper, Kew Bull. 26:579. 1972.
- C. ferax* L. C. Rich., Act. Soc. Hist. Nat. Paris 1:106. 1792. TYPE: Guiana. Cayenne, *Leblond* (HOLOTYPE: G, not seen; microfiche at GH!). *Mariscus ferax* (L. C. Rich.) C. B. Clarke, in J. D. Hook. Fl. Brit. India 6:624. 1894. *Torulinium ferax* (L. C. Rich.) Urb., Symb. Antill. 2:165. 1900.
- C. speciosus* Vahl, Enum. pl. 2:364. 1806. TYPE: not located; type locality: "America septentrionalis." *C. ferax* ssp. *speciosus* (Vahl) Kükenth., Pflanzenreich 4(20):619. 1936.
- C. haenkei* Presl, Reliq. Haenk. 1:172. 1828. TYPE: MEXICO. *Haenke* (PR?).
- C. ehrenbergii* Kunth, Enum. pl. 2:89. 1837. TYPE: VIRGIN ISLANDS. St. Thomas, *Ehrenberg* 77 (ISOSYNTYPE: HAL!).
- Diclidium aciculare* Schrad. ex Nees, Fl. bras. 2(1):55. 1842. TYPE: BRAZIL. Bahia, *Martius* (M). *C. acicularis* (Nees) Steud., Syn. Cyp. 45. 1854.
- C. macrocephalus* Liebm., Mexic. halvgr. 33. 1850. TYPE: MEXICO. Veracruz, Río Nautla at Pital, *Liebmann* 14367 (HOLOTYPE: C!; ISOTYPES: GH! HAL! K! LL!; photo:F! MICH!). *Torulinium macrocephalum* (Liebm.) Koyama, Phytologia 29:74. 1974.
- C. cubanus* Liebm., Mexic. halvgr. 34. 1850. TYPE: CUBA. near Havana, "in uliginosis," April 1845, *Liebmann* 14355 (HOLOTYPE: C!).
- C. rufinus* Liebm., Mexic. halvgr. 34. 1850. TYPE: MEXICO. Puebla, Tehuacán, S. Lorenzo, "ad ripas fluvis," Dec. 1842, *Liebmann* 14373 (HOLOTYPE: C!).
- C. sanctae-crucis* Liebm., Mexic. halvgr. 35. 1850. TYPE: VIRGIN ISLANDS. St. Croix, Lagunen ved Frederiksstad, *Oersted* 14374 (HOLOTYPE: C!).
- C. granadinus* Liebm., Mexic. halvgr. 36. 1850. TYPE: NICARAGUA. Granada, June, *Oersted* 14363 (HOLOTYPE: C!).
- C. oerstedii* Liebm., Mexic. halvgr. 36. 1850. TYPE: NICARAGUA. Segovia, January 1848, *Oersted* 14372 (HOLOTYPE: C!).
- C. fossarum* Liebm., Mexic. halvgr. 37. 1850. TYPE: MEXICO. Oaxaca, near Tehuantepec by Hacienda de Sta. Crux, "in fossis," December 1842, *Liebmann* 14359 (HOLOTYPE: C!; ISOTYPES: GH! K!).
- C. fragilis* Liebm., Mexic. halvgr. 38. 1850. TYPE: MEXICO. Veracruz, coast region by Paso de Doña Juana, Feb. 1841, *Liebmann* 14360 (HOLOTYPE: C!; ISOTYPE: K!).
- C. engelmannii* Steud., Syn. Cyp. 47. 1854. TYPE: U.S.A. Illinois, Cahokia, Sept. 1845, *Engelmann* (HOLOTYPE: P?; ISOTYPE: GH!). *C. ferax* ssp. *engelmannii* (Steud.) Kükenth., Pflanzenreich 4(20):620 1936.
- C. oxycarioides* Britton, Bull. Torrey Bot. Club 11:86. 1884. TYPE: U.S.A. Texas, valley of the lower Rio Grande, *Buckley s.n.* (HOLOTYPE: NY!).
- C. eggersii* Boeck., Cyp. nov. 1:53. 1888. TYPE: DOMINICAN REPUBLIC. Santo Domingo, near Batey on Río Yasica, 23 June 1887, *Eggers* 2627 (HOLOTYPE: B!). *Torulinium eggersii* (Boeck.) C. B. Clarke, Symb. Antill. 2:56. 1900.

ACKNOWLEDGMENTS

I would like to thank Prof. Robert L. Wilbur for his support and advice in the present study, the Gray Herbarium Library for access to literature, and the curators of the following herbaria for sending specimens: A, B, BH, BM, BR, C, CAS, CGE, CR, CU, DS, E, F, FLAS, GH, HAL, K, LCU, LL, M, MICH, MO, MSC, NY, PENN, PH, PMA, PRC, S, TEX, US, WIS, and Z.

REFERENCES

- AYERS, B. 1946. The genus *Cyperus* in Mexico. Cath. Univ. Amer. Biol. Stud. 1. xi + 103 pp.
- CORRELL, D. S. and M. C. JOHNSTON. 1970. Manual of the vascular plants of Texas. Texas Res. Found., Renner, Tex. xv + 1881 pp.
- DENTON, M. F. 1978. A taxonomic treatment of the Luzulae group of *Cyperus*. Contr. Univ. Mich. Herb. 11:197-271.
- EXELL, A. W. 1944. Catalogue of the vascular plants of S. Tomé. London: British Museum. xi + 428 pp.
- FERNALD, M. L. 1950. Gray's manual of botany, 8th ed. New York: American Book Co. lxiv + 1632 pp.
- KERN, J. H. 1974. *Cyperus*. In Flora Malesiana. 7(3):592-661.
- KOYAMA, T. 1978. Cyperaceae. In R. A. Howard, ed., Flora of the Lesser Antilles. 3:220-320.
- KÜKENTHAL, G. 1935-36. *Cyperus*. In A. Engler & L. Diels, eds., Das Pflanzenreich 4(20):1-671.
- LINNAEUS, C. 1753. Species plantarum. Stockholm. 1200 pp.
- O'NEILL, H. T. 1940. The sedges of the Yucatan Peninsula. Carneg. Inst. Wash. Misc. Papers 19.
- STANDLEY, P. C. 1931. The Cyperaceae of Central America. Fieldiana Bot. 8(4):239-292.
- . 1938. The flora of Costa Rica (*Cyperus*). Fieldiana Bot. 18:96-100.
- TUCKER, G. C. 1983. The taxonomy of *Cyperus* (Cyperaceae) in Costa Rica and Panama. Syst. Bot. Monogr. 2:1-85.
- VOSS, E. G. 1972. Michigan flora, pt. 1. Bloomfield Hills, MI: Cranbrook Inst. of Science.

PROVISIONAL SYNOPSIS OF THE SPECIES AND NATURAL HYBRIDS IN *DURANTA* (VERBENACEAE)

ROGER W. SANDERS

Fairchild Tropical Garden
11935 Old Cutler Road, Miami, FL 33156, U.S.A.

ABSTRACT

The taxonomy of *Duranta* L. is provisionally reviewed in the form of a synoptic key and synonymy list. Seventeen species, without infraspecific taxa, are recognized. In zones of geographic sympatry, twelve of the species have been involved in forming nineteen putative natural hybrids, eight of which have been described previously as species or varieties.

Duranta L. consists of several shrubby species ranging from Florida and Texas south to Argentina and Brazil. As a member of the Verbenaceae tribe Lantaneae, it is closely related to the large genus *Citharexylum* L. and *Rhaphithamnus* Miers of Latin America. However, it differs from these by the eight-loculed ovaries and by the fruiting calyces that enclose the mature mericarps. In several species the showy, bluish purple flowers and fleshy, bright yellow-orange fruits have led to their use as ornamentals.

I initiated an herbarium study of *Duranta* in anticipation of developing it as a major research project at Fairchild Tropical Garden (FTG). This would have combined the emphasis of FTG on tropical ornamentals and the Caribbean flora with both my interest in the Lamiales (Sanders, 1979; Sanders and Cantino, 1984) and my previous acquaintance with *Rhaphithamnus* (Sanders et al., 1983). However, upon borrowing specimens from the New York Botanical Garden (NY) and the Smithsonian Institution (US) (Holmgren et al., 1981), I discovered that most of the taxonomic problems are in the temperate and subtropical northern Andes, rather than in the lowlands of the Caribbean Basin. Thus, I have discontinued further study of *Duranta*.

In annotating the loans, I discovered that for a significant number of taxa my determinations differed from those previously made by Dr. Harold N. Moldenke, the foremost authority of the Verbenaceae. Actually, authors have disagreed over the disposition of species of *Duranta* throughout its history. Schauer (1847) recognized four, whereas Walpers (1845) acknowledged ten. Currently, Dr. Moldenke (*in schedula*) accepts about 30 species and 12 infraspecific taxa, but I believe there are only 17 species, none of which has well marked geographically coherent subdivisions. I agree with Dr. Moldenke that considerable variation exists in *Duranta*. However, many of the variants, which include named species, appear to be morphologically

intermediate to other more widespread taxa, as well as appear to occupy zones of geographic sympatry of those taxa. This suggests that the variants are hybrids or taxa of hybrid origin. Although there is not yet any direct evidence for hybrids, I have demonstrated natural hybridization in the related woody genus *Lantana* (unpublished). Because Dr. Moldenke apparently plans to revise *Duranta* (He has recently published revisions of a number of other genera (e.g., 1981a, b, c).) and because of my small sample, I see no need to provide complete descriptions but only to present a contrasting hypothesis of species delimitations. This synoptical treatment includes a key to species, a list of putative natural hybrids, synonymies, and abbreviated references to type specimens seen in the above loans. It is my hope that this paper will encourage other botanists to pursue the required field and laboratory studies to test the hypotheses herein proposed.

TAXONOMY

DURANTIA L.

DURANTA L., Sp. Pl. ed. 1, 637. 1753. LECTOTYPE: *Duranta erecta* L. (= *D. repens* L.). Lectotypification was by Hitchcock and Greene (1929) but may not be justified. They argue that, as of 1929, a type for *D. erecta* had been identified, whereas none for *D. repens* had been found. Moldenke and Moldenke (1983), however, cite specimen 806.1 in the Linnean Herbarium as the type of *D. repens*. Therefore, an indepth study into the lectotypifications of the two Linnean species names and of *Duranta* is needed.

KEY TO SPECIES

1. Thorns twig-like, composed of several nodes and internodes, often bearing bracts or reduced leaves, stout and abruptly aculeate at apex; Andes of northern Peru *D. cajamarcensis* Mold.
1. Thorns spine-like, composed of a single smooth internode, rarely with a single node bearing a pair of subsidiary thorns, rather slender and tapering aciculate 2
2. Inflorescence branches (esp. axillary ones) leafy, with at least 3 to 5 well developed leaves below the flowering portion or subtending the lower flowers 3
3. Leaves, branches and thorns decussate; thorns poorly developed, if present mostly shorter than leaves; axillary short-shoots with fascicled leaves usually poorly developed 4
4. Twigs tomentose and undersurface of leaves pubescent with spreading curled hairs; calyx 6–7 mm long, apicules (tips of calyx-teeth) 1.0–1.5 mm long; fruiting calyx closed at apex; corolla-tube ca 2 times longer than calyx (incl. apicules); lower elevations of southeast Brazil and adj. Argentina .. *D. vestita* Cham.
4. Twigs and undersurface of leaves glabrescent with scattered appressed hairs; calyx 3–5 mm long, apicules 0.5–1.0 mm long, fruiting calyx open at apex; corolla-tube ca 3 times longer than calyx; Bolivia and northern central Argentina *D. serratifolia* (Griseb.) Kuntze
3. Leaves, branches and thorns mostly ternate or alternate; thorns well developed at most nodes, mostly longer than leaves; axillary short-shoots with fascicled leaves well developed 5

5. Flowering calyx 3–4 mm long, mouth nearly truncate, the apicules less than 0.5 mm long, the tomentose sinus ornamentations broadly triangular and present only at mouth of calyx-tube; fruiting calyx open at apex; Andes of southern Peru *D. armata* Mold.
5. Flowering calyx (4–)4.5–8.0 mm long, mouth apiculate-sinuate, the apicules 0.5–1.0 mm long, the tomentose sinus ornamentations long triangular and extending down calyx-tube; fruiting calyx closed at apex 6
6. Leaf-blades mostly 0.5–1.7 cm long, usually glabrous; calyx 4–5 mm long; West Indies *D. arida* Britton & Wilson
6. Leaf-blades mostly 1.8–3.0 cm long, usually pubescent on undersurface; calyx 5–7 mm long; Andes of Ecuador and adj. Colombia and Peru *D. triacantha* A. L. Juss.
2. Inflorescence branches bracteate or with 1 or 2 much reduced leaves below the flowering portion 7
7. Margin of leaf-blades flat, not revolute (except slightly at base); leaf-lamina rather flat, not rugose, upper surface dull, glabrous, glabrescent or with a gray felt-like indumentum 8
8. Leaves ovate-lanceolate, long attenuate at apex; inflorescence consisting of only about three racemose branches (terminal branch + two axillary branches), individual branches mostly 20–40 cm long, thin and lax-pendulous; Martinique and cultivated *D. stenostachya* Todaro
8. Leaves ovate, elliptic or oblanceolate, rounded to acute or acuminate at apex; inflorescence consisting of 5 to 10 or more racemose branches (racemes or compound racemes), the lower ones often developed in the axils of foliage leaves, individual branches mostly 5–15 cm long, often arching or recurved but rather stout and not pendulous 9
9. Both surfaces of leaf with a velutinous or tomentose felt-like indumentum; Andes of southern Peru *D. peruviana* Mold.
9. Mature leaves glabrous, glabrescent or appressed pubescent but hairs not forming a continuous felt-like indumentum on both surfaces 10
10. Leaves coriaceous; flowering calyx 6.5–8.0 mm long, calyx-tube (especially the thickened ribs) glabrous to glabrescent (not to be confused with the dense internal hairs protruding from mouth of calyx), calyx-teeth triangular or attenuate but not apiculate or subulate; fruiting calyx closed with a straight or slightly curved beak 2.5–5.0 mm or more long; Andes of Colombia and Ecuador and adj. Peru *D. obtusifolia* HBK
10. Leaves membranous, chartaceous or subsucculent; flowering calyx 2.5–5.5 (–6.5) mm long including calyx-teeth (If the calyx is longer than 5.5 mm, then the calyx-tube is pubescent on the outside and calyx-teeth are apiculate-subulate.); fruiting calyx twisted or open at the apex but not forming a straight or slightly curved beak 2.5–5.0 mm long 11
11. Flowering calyx tubular, apicules mostly 0.5–1.0 mm long; fruiting calyx closed at apex with a more or less twisted beak 0.5–2.0 mm long; corolla-tube (6–)7–9

- mm long, ca 2 times or less as long as the calyx including apicules; southern US to Brazil and cultivated *D. repens* L.
11. Flowering calyx campanulate, apicules 0.5 mm or less long; fruiting calyx open at apex; corolla tube ca 3 times longer than calyx 12
12. Leaves long elliptic or oblanceolate, entire, subsucculent with the secondary veins (those arising from the midrib or primary vein) obscure and more or less opposite; calyx apicules ca 0.1–0.2 mm long; corolla tube ca 8 mm or less long; Amazon and Orinoco Basins of Colombia *D. woronowii* Mold.
12. Leave ovate or broadly elliptic, usually sharply serrate, membranous with the secondary veins raised (below) and more or less alternate; calyx apicules mostly 0.3–0.5 mm long; corolla tube (9-)10–12 mm long, lower and middle slopes of Andes of Bolivia and northern Argentina ... *D. serratifolia* (Griseb.) Kuntze
7. Margin of leaf-blades revolute; leaf-lamina rugose, upper surface shiny or also with a brownish tomentose-lanate indumentum 13
13. Leaf-blades tomentose-lanate above, pubescent below, obovate to rounded elliptic; calyx 3–4 mm long; corolla-tube (9-)10–14 mm long; Andes of southern Colombia to central Peru *D. dombeyana* Mold.
13. Leaf-blades at least glabrescent or shiny above, of various shapes; calyx 5–9 mm long; corolla-tube mostly less than 10 mm long 14
14. Mature twigs glabrescent or puberulent; leaf-blades 1–6(-8) cm long, undersurface glabrous or glabrescent with scattered hairs or with pubescent veins 15
15. At anthesis leaves on the long-shoots caducous and absent but fascicled leaves well developed and present; leaf-blades obovate to oblanceolate; individual racemes mostly 1–4 cm long; calyces mostly 5–7 mm long, the apicules 0.5 mm or less long; southern Mexico and Central America *D. guatemalensis* Mold.
15. At anthesis leaves on the long-shoots persistent but fascicled leaves lacking or poorly developed; leaf-blades lanceolate or ovate to obovate; individual racemes mostly 4–15 cm long; calyces mostly 8–9 mm long, the apicules 0.7–1.5 mm long 16
16. Leaf-blades mostly 2.5–6.0 cm long, ovate, oblong or broadly oblong-elliptic, apex acute or acuminate; Andes and other mts. from Venezuela to Peru *D. mutisii* L. f.
16. Leaf-blades mostly 1–2(-3) cm long, obovate to long elliptic, apex rounded or retuse, mucronate; Andes from Colombia to Bolivia *D. mandonii* Mold.
14. Mature twigs $\pm$ tomentose; leaf-blades (3-)6–12 cm long, undersurface tomentose or pubescent with spreading hairs 17
17. Leaf-blades mostly narrowly ovate, apex attenuate; calyx-apicules ca 2 mm long; Central America *D. costaricensis* (J. D. Smith) Standl.
17. Leaf-blades mostly ovate to elliptic, apex acute; calyx-apicules ca 1 mm long; Andes from Venezuela to Bolivia *D. sprucei* Briq.

SPECIES: SYNONYMIES, TYPES SEEN, AND NOTES

1. DURANTA REPENS L., Sp. Pl. ed. 1, 637. 1753. PROBABLE TYPE: Linn.

Herb. 806.1 (Microfiche!-IDC 177, card 422, row 1, column 5). Kuntze (1891) was the first author to combine *D. repens* and *D. erecta* and, in so doing, gave priority to *D. repens*.

Duranta erecta L., Sp. Pl. ed. 1, 637. 1753. POSSIBLE TYPE: Linn. Herb. 806.2 (Microfiche!-IDC 177, card 422, row 1, column 6).

Duranta ellisia Jacq., Enum. Pl. Carib. 26. 1760.

Duranta plumieri Jacq., Select. Stirp. Amer. Hist. 186, pl. 176, fig. 76. 1763.

Duranta racemosa Mill., Gard. Dict., ed. 8, 1768. "Durantia racemosa". TYPE: JAMAICA. Houston s.n. (Photo: NY!).

Duranta angustifolia Salisb., Prod. Stirp. Hort. Allerton 108. 1796.

Duranta latifolia Salisb., Prod. Stirp. Hort. Allerton 108. 1796.

Duranta dentata Rich. ex Pers., Syn. Pl. 2:142. 1806.

Duranta xalapensis HBK., Nov. Gen. Sp. 2:255. 1818. TYPE: MEXICO. Humboldt & Bonpland s.n. (Microfiche!-IDC 6209, card 47, row 2, column 1).

Duranta microphylla Desf., Cat. Hort. Paris (Tabl. Ecole Bot., ed. 3) 392. 1829.

Duranta repens var. *microphylla* (Desf.) Mold., Phytologia 1:483. 1941.

Duranta plumieri var. *strigillosa* Schauer in Mart., Fl. Braz. 9:271. 1851.

Duranta integrifolia Todaro, Nuovi Gen. Nuove Sp. Palermo 27. 1858.

Duranta turbinata Todaro, Nuovi Gen. Nuove Sp. Palermo. 28. 1858.

Duranta parviflora Turcz., Bull. Soc. Nat. Moscow 36(2): 210. 1863.

Duranta repens var. *canescens* Mold., Phytologia 1:436. 1940.

Duranta peruviana Mold. var. *longipedicellata* Mold., Bull. Torrey Bot. Club 68:502. 1941. TYPE: Herrera 3209 (Photo of HOLOTYPE: NY!).

Duranta repens var. *serrata* Mold., Phytologia 7:81. 1959. TYPE: Venturi 9059 (HOLOTYPE: NY!).

Duranta repens var. *lopez-palacii* Mold., Phytologia 26:177. 1973. TYPE: Ruiz & Lopez 1923 (HOLOTYPE: NY!).

Kuntze (1891) published what appears to be eight varietal names under *D. repens*: α *multidentata*, β *paucidentata*, φ *mutisii*, 1. *acuta*, 2. *obtusifolia*, 3. *acuminata*, a) *glabrifolia*, and b) *vestita*. The first three are based on characters of the leaf margin; the next three on leaf apices; and the last two on leaf indument. Upon closer inspection, it is clear that Kuntze intended that for any given plant the varietal name is to be a combination of three epithets, depending on the expression of the three leaf characters. Thus, for the taxon that I interpret as *D. costaricensis*, Kuntze gives the name *D. repens* var. *mutisii* & *acuminata* & *vestita*. In that a given name can be used with two or more taxa and the varietal names are not single epithets, I conclude that none of the above names are validly published (International Code of Botanical Nomenclature, Arts. 24.1, 32.1, 33.1, and 34.1b).

Duranta repens is very variable, especially with respect to habit, to the overall shape, margins and apex of the leaf, and to the presence and size of thorns. It is also subject to pathological elongation of the calyx and corolla. The variation is not well correlated with geography. However, specimens from the montane region of extreme northeastern Colombia to central Venezuela probably form a distinctive geographic race. If recognized, it would take the name *D. repens* var. *canescens* (incl. *D. repens* var. *lopez-palacii*). *Duranta peruviana* and *D. stenostachya* may be conspecific with

D. repens, each forming a geographic race. However, much more work is needed to delimit all the geographic subdivisions of *D. repens*; until then, infraspecific taxa should not be recognized.

Moldenke also recognizes as taxa three other variants that are found mostly in cultivation. These are relegated to the status of cultivars.

a. *D. REPENS* 'Alba'

D. plumieri var. *alba* Masters, Gard. Chron. 63 (ser 3, 3):44. 1888.

D. erecta var. *alba* (Masters) Caro, Rev. Argent. Agron. 23:11. 1956.

D. repens var. *alba* (Masters) Mold., Phytologia 41:449. 1979.

b. *D. REPENS* 'Macrodonata'

D. macrodonata Mold., Phytologia 2:16. 1941. TYPE: 21 Oct 1924, Nur & Ghose s.n. (Photo of HOLOTYPE: NY!).

c. *D. REPENS* 'Grandiflora'

D. repens var. *grandiflora* Mold., Phytologia 2:17. 1941.

D. erecta var. *grandiflora* (Mold.) Caro, Rev. Argent. Agron. 23:10. 1956.

2. *DURANTA STENOSTACHYA* Todaro, Nuovi Gen. Nuove Sp. Palermo 26. 1858. POSSIBLE TYPE: Plate 3, Tod. Herb. Bot. Palermo in Herb. Berlin (Photo of plate: NY!).

3. *DURANTA PERUVIANA* Mold., Bull. Torrey Bot. Club 68:501. 1941. TYPE: Soukup 825 (Fragment of HOLOTYPE: NY!).

4. *DURANTA OBTUSIFOLIA* HBK., Nov. Gen. Sp. 2:254. 1818. TYPE: PERU. Humboldt & Bonpland s.n. (Microfiche!-IDC 6209, card 47, row 1, column 7).

Duranta coriacea Hayek, Fedde Rep. Nov. Sp. 2:88. 1906.

5. *DURANTA WORONOWII* Mold., Bull. Torrey Bot. Club 68:503. 1941. TYPE: Woronow & Juzepczuk 6243 (Photo of HOLOTYPE: NY!).

6. *DURANTA SERRATIFOLIA* (Griseb.) Kuntze. Rev. Gen. 3(2):251. 1893.

Myrtus serratifolia Griseb., Pl. Lorentz. 91, t.1, fig. 4. 1874. PROBABLE TYPE: Lorentz & Hieronymus 491 (Photo: NY!).

Duranta lorentzii Griseb., Symb. Fl. Argent. (Goett. Abh. 24):280. 1879. PROBABLE TYPE: Lorentz & Hieronymus 491 (Photo: NY!).

Duranta serratifolia var. *punctata* Caro, Rev. Argent. Agron. 23:19. 1956.

7. *DURANTA VESTITA* Cham., Linnaea 7:115. 1832.

Duranta plumieri var. (β) *vestita* (Cham.) Schauer in Mart., Fl. Braz. 9:271. 1851.

8. *DURANTA MUTISII* L. f., Suppl. Pl. 291. 1781. PROBABLE TYPE: Mutis 6, Linn. Herb. 803.3 (Photo: NY!).

Duranta macrocarpa HBK., Nov. Gen. Sp. 2:255. 1818. TYPE: Humboldt & Bonpland s.n. (Photo: NY!; Microfiche!-IDC 6209, card 47, row 2, column 2).

Duranta brachypoda Todaro, Nuovi Gen. Nuove Sp. Palermo 24. 1858.

Duranta steyermarkii Mold., Fieldiana, Bot. 28(3):515. 1953. TYPE: Steyermark 62102 (HOLOTYPE: NY!).

Duranta mutisii f. *serrulata* Mold., Phytologia 23:454. 1972. TYPE: *Allart* 325 (HOLOTYPE: NY!).

Duranta boekei Mold., Phytologia 40:260. 1978. TYPE: *Boeke* 644 (HOLOTYPE & ISOTYPE: NY!).

D. mutisii is rather variable with regard to leaf shape and size and other features, and it may possibly include *D. sprucei* and *D. mandonii*.

9. DURANTA MANDONII Mold., Lilloa 5:390. 1940. TYPE: *Mandon* 533 (HOLOTYPE & ISOTYPE: NY!).

10. DURANTA SPRUCEI Briq., Bull. Herb. Boiss. 4:344. 1896. TYPE: *Spruce* 5526 (ISOTYPE: NY!).

Duranta benthamii Briq., Bull. Herb. Boiss. 4:343. 1896. PROBABLE TYPE: *Mandon* 534 (ISOTYPE: NY!).

Duranta tomentosa Hayek, Fedde Rep. Nov. Sp. 2:88. 1906.

Duranta pseudorepens Mold., Phytologia 1:460. 1940. TYPE: *Spruce* 6042 (HOLOTYPE: NY!).

Duranta sprucei var. *columbiensis* Mold., Phytologia 2:18. 1941. TYPE: *Apolinar-María* 263 (Photo: NY!).

Duranta sprucei var. *breviracemosa* Mold., Phytologia 2:409. 1948. TYPE: *Haught* 6097 (HOLOTYPE: NY!; ISOTYPE: US!).

Duranta dombeyana Mold. var. *espinosae* Mold., Phytologia 9:186. 1963. TYPE: *Espinosa* 1815 (HOLOTYPE: NY!).

Duranta sprucei var. *cotopaxiensis* Mold. Phytologia 51:244. 1982.

Duranta sprucei is rather variable with respect to leaf shape, to density of foliar hairs, to thorn development, and to length of the racemes. This may stem from hybridization rather than geographic variation. As Moldenke's varieties seem to be sympatric with the more typical plants, I prefer not to recognize them as taxonomic varieties.

11. DURANTA COSTARICENSIS (J. D. Smith) Standl., Field Mus. Publ. Bot. 18(3/4):1005. 1938.

Duranta mutisii var. *costaricensis* J. D. Smith. Bot. Gaz. 20:9. 1895. TYPE: *Cooper* 6007 (LECTOTYPE?: US!; ISOTYPES: NY! US!).

12. DURANTA GUATEMALENSIS Mold., Bull. Torrey Bot. Club 68:501. 1941. TYPE: *Heyde & Lux* 2947 (Photo and fragments of HOLOTYPE: NY!; ISOTYPES: US!).

13. DURANTA DOMBEYANA Mold., Bull. Torrey Bot. Club 68:500. 1941. TYPE: *Rose et al.* 23347 (HOLOTYPE: NY!; ISOTYPE: US!).

The pubescence may slough off the upper surface of the leaves with age, but the species is distinct because of the long corolla tubes and very short calyces.

In NY there is a photograph of *Ruiz & Pavon s.n.* from Huassahuassi, Junín, Peru that is annotated by Dombey as *D. tomentosa* and by McBride as *D. dombeyi*. The latter name appears not to have been published.

14. DURANTA TRIACANTHA A. L. Juss., Ann. Mus. Paris 7:77. 1806. PROBABLE TYPE: Spec. Herb. Juss. (Photo: NY!).

Duranta hitchcockii Mold., Phytologia 1:460. 1940. TYPE: *Hitchcock* 20821 (HOLOTYPE: NY!; ISOTYPE: US!).

15. DURANTA ARIDA Britton & Wilson, Mem. Torrey Bot. Club 16:96. 1920. TYPE: *Shafer* 7904 (HOLOTYPE: NY!).

Duranta erecta var. *domingensis* Urban, Symb. Antill. 7:355. 1912. *D. repens* var. *domingensis* (Urban) Mold., Rev. Sudam. Bot. 4:17. 1937. *D. arida* var. *domingensis* (Urban) Mold., Carib. Forest. 2:13. 1940.

Duranta fletcheriana Mold., Carib. Forest. 2:13. 1940. TYPE: *Leon* 10865 (HOLOTYPE: NY!).

16. DURANTA ARMATA Mold., Bull. Torrey Bot. Club 68:499. 1941. TYPE: *Herrera* 85 (Photo and fragment of HOLOTYPE: NY!).

17. DURANTA CAJAMARCENSIS Mold., Phytologia 17:344. 1968.

I saw only two specimens (MO) annotated by Dr. Moldenke as belonging to this species. The material lacked good flowers and fruits, but the twiglike thorns were apparent. If the thorn character is consistent, this is probably a distinct species; otherwise, it may be only a variant of *D. triacantha*.

PUTATIVE NATURAL HYBRIDS AND SYNONYMIES

1a. DURANTA REPENS X VESTITA

Duranta vestita var. *glabrescens* Mold., Phytologia 2:364. 1947. TYPE: 14 Dec 1938, *Kiehl & Costa s.n.* (HOLOTYPE: NY!).

Duranta parvifolia Mold., Phytologia 2:464. 1948. TYPE: *Barreto* 11057 (HOLOTYPE: NY!).

As one of Dr. Moldenke's varietal epithets suggests, this hybrid is similar to *D. vestita* but lacks the dense hairs.

1b. DURANTA REPENS X ARIDA

Duranta wrightii Mold., Phytologia 3:60. 1949. TYPE: *Wright* 1358 (HOLOTYPE: NY!).

This hybrid usually has the ternate thorns of *D. arida*, but the leaves are larger and not as distinctly fascicled.

1c. DURANTA REPENS X COSTARICENSIS

Leaves less coriaceous, rugose, and pubescent than in *D. costaricensis*.

Other specimens suggest hybrids between *D. repens* and other species, including *D. mutisii* and *D. sprucei*, but the species pairs are not geographically sympatric, arguing against hybridization.

2a. DURANTA OBTUSIFOLIA X MUTISII

This is recognized by the leaves with an intermediate development of revolute margins, acute to cuspidate apices, shiny surfaces, rugose laminae and by the glabrescent calyx.

2b. DURANTA OBTUSIFOLIA X MANDONII

Similar to 2a, but leaves smaller and more obovate.

2c. *DURANTA OBTUSIFOLIA* X *SPRUCI*

Similar to 2a, but with the leaves pubescent below.

2d. *DURANTA OBTUSIFOLIA* X *TRIACANTHA*

Leaves smaller and more rounded than in *D. obtusifolia*, with the ternate thorns of *D. triacantha* and calyces of *D. obtusifolia*.

3a. *DURANTA SERRATIFOLIA* X *SPRUCI*

Duranta recurvistachys Rusby, Phytologia 1:73. 1934. TYPE: *Bang* 1798 (HOLOTYPE & ISOTYPES: NY!).

Leaves barely revolute, serrate but somewhat coriaceous and rugose; calyx smaller than in *D. sprucei*.

4a. *DURANTA MUTISII* X *SPRUCI*

Most plants of this combination show leaves of intermediate shape and/or abaxial pubescence.

4b. *DURANTA MUTISII* X *TRIACANTHA*

Ternate thorns; leaves more obovate and somewhat smaller than in *D. mutisii* but rather revolute and rugose; the racemes usually leafy.

4c. *DURANTA MUTISII* X *ARMATA*

Duranta lineata Hayek in Urban, Bot. Jahrb. 42:170. 1908. TYPE: *Weberbauer* 3286 (Photo: NY!).

Well developed alternate or ternate thorns; leaves as in 4b, usually not strongly fascicled; calyces shorter than in *D. mutisii* but with rather long apicules.

5a. *DURANTA MANDONII* X *TRIACANTHA*

Similar to 4b, but leaves smaller and more obovate-spatulate.

5b. *DURANTA MANDONII* X *ARMATA*

Duranta rupestris Hayek in Urban, Bot. Jahrb. 42:171. 1908. TYPE: *Weberbauer* 1759 (Photo: NY!).

Similar to *D. armata*, but leaves somewhat larger, revolute, and rugose; calyces 4–8 mm long.

6a. *DURANTA SPRUCI* X *TRIACANTHA*

Duranta penlandii Mold., Phytologia 1:461. 1940. TYPE: *Penland & Summers* 958 (HOLOTYPE: NY!).

Similar to 4b, but leaves pubescent below.

6b. *DURANTA SPRUCI* X *ARMATA*

Similar to 4c, but leaves pubescent below.

7a. DURANTA DOMBEYANA X MUTISII

With the leaves of *D. mutisii* and flowers of *D. dombeyana*.

7b. DURANTA DOMBEYANA X MANDONII

Duranta skottsbergii Mold., Bull. Torrey Bot. Club 68:502. 1941. TYPE: *Macbride & Featherstone 1484* (Fragments and photo of HOLOTYPE: NY!; ISO-TYPE: US!).

With the leaves of *D. mandonii* and flowers of *D. dombeyana*.

7c. DURANTA DOMBEYANA X TRICANTHA

Ternate thorns; leaves rather tomentose, fascicled; calyx 5–7 mm long and corolla tube long exserted.

7d. DURANTA DOMBEYANA X ARMATA

Similar to 7c, but thorns less consistently ternate and leaves smaller.

EXCLUDED SPECIES

DURANTA FISCHERI Mart., Herb. Fl. Braz. 21(2): Beibl. 60. 1838.

= *Casselia integrifolia* Nees & Mart. var *fischeri* (Mart.) Mold.

DURANTA PEARCEI Rusby, Bull. N.Y. Bot. Gard. 4:433. 1907.

= *Bredemeyera densiflora* A. W. Benor (Polygalaceae).

DURANTA JOERGENSENII Lillo, Prim. Reun. Nac. Soc. Argent. Cienc. Nat. (Tucuman) 224. 1919.

= *Citharexylum joergensenii* (Lillo) Mold.

ACKNOWLEDGMENTS

The curators of NY and US are thanked for the loans of *Duranta*. Missouri Botanical Garden and Ohio State University provided use of their libraries and herbaria. Helen Correll and Walter Judd provided criticisms of the manuscript.

REFERENCES

- HITCHCOCK, A. S. & M. L. GREEN. 1929. Int. Bot. Congr. Cambridge (England), 1930, Nom. Prop., 111–199.
- HOLMGREN, P. K., W. KEUKEN & E. K. SCHOFIELD. 1981. Index Herbariorum, Part I, ed. 7 (Reg. Veg. 106). Bohn, Scheltema & Holkema, Utrecht.
- KUNTZE, C. E. O. 1891. Revisio Generum Plantarum 2:507.
- MOLDENKE, H. N. 1981a. Notes on the genus *Ghinia* (Verbenaceae). *Phytologia* 47:404–419.
- . 1981b. Notes on the genus *Holmskoidia* (Verbenaceae). *Phytologia* 48:313–356.
- . 1981c. Notes on the genus *Geunsia* (Verbenaceae). *Phytologia* 50:46–68.
- and A. L. MOLDENKE. 1983. Verbenaceae. In M. D. Dassanayake and F. R. Fosberg, eds. *Rev. Handb. Flora Ceylon* 4:196–487.
- SANDERS, R. W. 1979. A systematic study of *Agastache* section *Brittonastrum* (Lamiaceae, Nepeteae). Ph.D. Dissertation. University of Texas, Austin.
- and P. D. CANTINO. 1984. The nomenclature of the subdivisions of the Lamiaceae. *Taxon* 33:64–72.

- _____, T. F. STUESSY & R. RODRIGUEZ. 1983. Chromosome numbers from the flora of the Juan Fernandez Islands. *Amer. J. Bot.* 70:799–810.
- SCHAUER, J. C. 1847. Verbenaceae. *In* A. DeCandolle, ed. *Prodromus Systematis Naturalis Regni Vegetabilis* 11:522–700.
- WALPERS, W. G. 1845. *Duranta*. *In* W. G. Walpers, ed. *Repertorium Botanices Systematicae* 4:78–80.

SIDUS SIDARUM—IV.
A NEW RECORD OF *SIDA* IN NORTH AMERICA,
S. SANTAREMENSIS (MALVACEAE).

PAUL A. FRYXELL

*U.S. Dept. Agric. & Texas A&M University
College Station, TX 77843, U.S.A.*

ANTONIO KRAPOVICKAS

*Universidad Nacional del Nordeste
Corrientes, Argentina*

DAVID CREWZ

*Bureau of Marine Research, Florida Dept. of Natural Resources
St. Petersburg, FL 33731, U.S.A.*

Recent collections of *Sida* in and around Tampa, Florida (cited below) proved initially difficult to identify, when considered against the relatively few species of that genus known to occur in Florida. An initial suggestion of hybrid origin, supported by a very restricted distribution in proximity to putatively parental species (*S. acuta* Burm. f. and *S. cordifolia* L.), was not supported by the evident fertility of the plants in question nor is it supported by the taxonomic view that the two putative parents belong to different sections of the genus (Fryxell, 1985).

The problem was resolved when one of us (AK) recognized the plant in question to be *Sida santaremensis* Monteiro, described from Brazil and found also in Argentina and Bolivia. Comparison of the Florida plant with a range of specimens from South America (including a specimen from the type locality of Santarem in Pará Brazil) leaves no doubt as to the identification of the Florida material (cf. also Kearney, 1958). Since the original description of this species is not readily available, a redescription of the plant is included in this paper.

Presumably the plant is a recent introduction to Florida. Whether the initial propagules arrived by human-mediated transport, by birds, or by some other means is not known. However, the recognition of this introduction soon after its arrival (apparently) provides an opportunity to observe its subsequent spread and establishment in the the flora of the region—or its failure to spread and establish—and to observe its comparative competitiveness with other species of *Sida* already occurring in the area.

SIDA SANTAREMENSIS Monteiro, Monogr. Malvac. Bras. Fasc. I. *Sida*, 44. 1936.

Well-branched subshrub up to 1 m tall, the stems sparsely and minutely stellate-pubescent. Leaf blades broadly elliptic to subrhomboid, at base truncate to rounded, dentate almost to the base (the teeth finer proximally than distally), acute, up to 5.5 cm long, 3.5 cm wide, smaller and narrower upward, minutely and evenly stellate-pubescent, densely so beneath, slightly discoloured; petioles 3–10 mm long, densely stellate-pubescent distally; stipules linear, 7 mm long, 1-nerved. Pedicels usually solitary in the leaf axils, slender, up to 2 cm long; calyx 6–7 mm long, minutely and evenly stellate-pubescent, 10-ribbed at the base, the lobes triangular-apiculate; petals ca 1 cm long, cream-colored with reddish-brown spot at base; androecium pallid, the anthers yellowish. Fruits oblate-conical, more or less enclosed by calyx lobes; mericarps ca 11, short -apiculate (and with a few antrorse hairs) apically, the dorsal wall somewhat sunken, the lateral walls smooth to obscurely reticulate.

FLORIDA: Hillsborough Co.: sandy disturbed area near north restroom at Lettuce Lake Park, north of Tampa, 11 Oct 1981 [in flower], *Crewz & Lindsay* 2271 (STPE, USF, pf), 24 Nov 1981 [in fruit], *Crewz & Heath* 2350 (pf).

An additional population has been observed in Tampa in a sandy road margin adjacent to mesic woods at the dead end of Ojus Dr. ca 100 m south of East 98th Avenue.

REFERENCES

- FRYXELL, P. A. 1985. *Sidus sidarum*—V. The North American and Central American species of *Sida*. *Sida* [in press].
 KEARNEY, T. H. 1958. A tentative key to the South American species of *Sida*. *Leaflet W. Bot.* 8:249–270.

NOTES

A NEW COMBINATION IN THE POACEAE—A new combination in the Poaceae is necessary due to the "Demoulin" rule (amended Article 19) that was adopted for the International Code of Botanical Nomenclature by the Sydney Congress. This nomenclatural change is made so the name will be available for use in the Chihuahuan Desert Flora being written by Marshall C. Johnston and James Henrickson. The combination is as follows:

SCHIZACHYRIUM SANGUINEUM (Retz.) Alston var. **HIRTIFLORUM** (Nees) Hatch, comb. nov.

Schizachyrium hirtiflorum Nees, Agrost. Bras. 336. 1829. TYPE: BRAZIL. AUSTRALIORI: *Sellow s.n.*

S. sanguineum (Retz.) Alston var. *brevipedicellatum* (Beal) Hatch.

—This is Technical Bulletin No. T.A. 19771, Texas Agricultural Experiment Station.—*Stephan L. Hatch, S. M. Tracy Herbarium, Department of Range Science, Texas A&M University, College Station, TX 77843, U.S.A.*

AN ADDITION TO THE NEW MEXICO FLORA, *GLOSSOPETALON PLANITIERUM* (CROSSOSMATACEAE).—*Glossopetalon planitierum* (Ensign) St. John (= *Forsellesia planitierum* Ensign) was first attributed to the New Mexico flora by Barkley et al. (Barkley et al., *Atlas of the flora of the Great Plains*, 1977). They reported the species for Quay County in east-central New Mexico. However, W. C. Martin and C. R. Hutchins (Martin & Hutchins, *A flora of New Mexico*, 1980) listed only *G. spinescens* A. Gray as occurring in New Mexico. The Barkley et al. (op. cit.) record is based upon specimens at KANU. These were re-examined and found to be properly determined. The leaves of *G. planitierum* have a pair of obvious stipules (about 1 mm long) at the base of the petioles, distinguishing it from the estipulate *G. spinescens*.

On deposit at the University of Kansas Herbarium (KANU) are three sheets of *Glossopetalon planitierum* collected from a single station of Quay County New Mexico: 8 miles south San Jon, rough eroded base of mesa dry, rocky sandstone soil, few plants, 26 Jul 1968, *Steve Stephens 25575 & Ralph Brooks*; 8 miles south San Jon, side of small sandstone canyon, rocky, sandy soil, common, 17 May 1974, *Steve Stephens 75784*; 5 miles north Wheatland (se $\frac{1}{4}$, sec 20, T9N, R34E), ridge of the Bluffs of Llano Estacado, common on dry outcrops, 10 Jul 1979, *Ralph Brooks 14288*. The New Mexico site represents a short western range extension for *G. planitierum* that was otherwise known only from Cimarron County, Oklahoma and scattered localities in the Texas Panhandle (Ensign, *A revision of the celastraceous genus Forsellesia* (Glossopetalon), *Amer. Midl. Naturalist*

27:501–511. 1942)—*Ralph E. Brooks, University of Kansas Herbarium, 2045 Constant Avenue, Campus West, Lawrence, KS 60644, U.S.A.*

SCIRPUS CERNUUS VAHL VAR. *CALIFORNICUS* (TORR.) BEETLE (CYPERACEAE) NEW TO TEXAS.—*Scirpus cernuus* var. *californicus* (*S. riparius* (R. Br.) Spreng.) is a tufted annual with nearly filiform culms 4–20 cm tall. The North American variety has been previously reported in wet places near the coast from British Columbia south to Mexico (Beetle, 1944). Mason (1957) reported it from California from the coastal marshes and tidal flats inland to Riverside and San Bernardino counties. Correll and Johnston (1970), Correll and Correll (1975), and Gould (1975) did not report it from Texas. *Scirpus cernuus* var. *californicus* is similar to *S. koilolepis* (Steud.) Gl. and *S. molestus* M. C. Johnston, but can be distinguished on the basis of achene size and basal sheath color. Achenes of *S. cernuus* var. *californicus* are 0.7–0.9 mm long while those of *S. koilolepis* and *S. molestus* are 0.8–1.5 mm long. The basal sheaths of *S. cernuus* var. *californicus* are reddish to purplish, while those of *S. koilolepis* and *S. molestus* are grayish-green to brownish-stramineous, never reddish or purplish.

Five specimens of *S. cernuus* var. *californicus* have been collected from the south central coastal plains.

The collection data are: Brazoria Co.: sandy beach about 9 mi E of Surfside, 25 Mar 1976, *Taylor 21094* (DUR, NLU). Harris Co.: NW shore of Galveston Bay near Barber's Cut Terminal at Morgan's Point, 16 May 1979, *Brown 4407* (SBSC), 28 Mar 1984, *Brown 6978* (SBSC, TEX), 28 Apr 1984, *Brown 7225* (SMU, TAES); vacant lot in Rio Villa subdivision near intersection of Wallisville Rd. and San Jacinto River, 4 Apr 1984, *Brown 7051* (SMU).

—*James W. Kessler, S. M. Tracy Herbarium, Dept. of Range Science, Texas A&M University, College Station, TX, 77843, U.S.A., and Larry E. Brown, Houston Community College, 726 Horncastle, Channelview, TX, 77530, U.S.A.*

REFERENCES

- BEETLE, A. A. 1944. Three neglected names in *Scirpus*. *Rhodora* 46:145–146.
 CORRELL, D. S. and H. B. CORRELL. 1975. Aquatic and wetland plants of southwestern United States. Vol. 1. Stanford University Press, Stanford.
 CORRELL, D. S. and M. C. JOHNSTON. 1970. Manual of the vascular plants of Texas. Texas Research Station, Renner.
 GOULD, F. W. 1975. Texas plants: A checklist and ecological summary (Revised). Texas Agricultural Experimental Station, College Station.
 MASON, H. L. 1957. A flora of the marshes of California. University of California Press, Berkeley.

TWO ADVENTIVE SPECIES OF GRASSES, *APERIA INTERRUPTA* AND *DESCHAMPSIA DANTHONIOIDES* (POACEAE), NEW TO THE OHIO FLORA—On 11 June 1980, two grasses, *Apera interrupta* (L.)

Beauv. and *Deschampsia danthonioides* (Trin.) Munro ex Benth., were first discovered by us for Ohio. Neither species previously has been reported from the state (Weishaupt 1967, 1971), and the latter is new to the *Gray's Manual* range (Fernald 1950).

These two grasses were scattered in freshly-disturbed earth adjacent to a newly-constructed church in the city of Sylvania, Lucas County. The substrate was a light sand typical of the post-glacial lake ridges of northwestern Ohio. Voucher specimens of both species have been deposited at OS.

Apera interrupta is an annual similar in appearance to *Agrostis*. Indeed, some manuals treat it as *Agrostis interrupta* L. (Gleason & Cronquist 1963; C. Hitchcock 1969). *Apera interrupta* is a native of sandy, open habitats in central and western Europe (Tutin 1980). The first known specimen of this grass from North America was collected at the Missouri Botanical Garden, St. Louis, in 1904 (Steyermark 1963). It was not obtained again on this continent until 1918, when it was located in British Columbia (Constance & Dillon 1935). *Apera interrupta* subsequently has been reported from California, Hawaii, Idaho, Ogden, Utah, and Washington (A. Hitchcock 1951; Holmgren & Holmgren 1977; Munz 1968; Rotar 1968). The Ohio specimen is apparently the first from east of the Mississippi River.

Deschampsia danthonioides (annual hairgrass) is indigenous to open habitats and waste ground in western North America from Alaska and the Yukon south to Baja California and east to western Montana, Utah, and Arizona. It also has been reported from Argentina and Chile (A. Hitchcock 1951; Holmgren & Holmgren 1977).

Because both *Apera interrupta* and *Deschampsia danthonioides* occur in the northwestern United States, it is conceivable that the two species spread simultaneously from this region. Possibly the seeds were conveyed in lawn seed or with building material transported to the Ohio construction site.

In 1983 Cusick revisited the Sylvania locality where these two grasses had been collected. Construction work had been completed and the sandy, disturbed lot had been sodded. No trace was found of either species. However, numerous new construction sites in the city of Sylvania provide ample habitat for these annuals. Further botanical investigation may locate additional stations, which only then will reveal if either of these grasses persists in the spontaneous Ohio flora.

Our field work was supported by the Ohio Department of Natural Resources, Division of Natural Areas and Preserves.—*Allison W. Cusick, Division of Natural Areas and Preserves, Ohio Department of Natural Resources, Columbus, OH 43224; David M. Brandenburg, Department of Botany and Microbiology, University of Oklahoma, Norman, OK 73019, U.S.A.*

REFERENCES

- CONSTANCE, L. and L. A. DILLON. 1935. New or otherwise noteworthy northwestern plants. I. *Madroño* 3:170–173.

- FERNALD, M. L. 1950. Gray's manual of botany, ed. 8 American Book Co., New York. lxiv + 1632 pp. (Reprinted, D. Van Nostrand Co., New York, 1970).
- GLEASON, H. A. and A. CRONQUIST. 1963. Manual of vascular plants of north-eastern United States and adjacent Canada. D. Van Nostrand Co., New York li + 810 pp.
- HITCHCOCK, A. S. 1951. Manual of the grasses of the United States, ed. 2, rev. by A. Chase. U.S. Dept. Agric. Misc. Publ. 200. 1051 p.
- HITCHCOCK, C. L. 1969. Gramineae, pp. 384–725. In: Hitchcock, C. L., A. Cronquist, and M. Ownbey. Vascular plants of the Pacific northwest. Part I: Vascular cryptogams, gymnosperms, and monocotyledons. Univ. Washington Press, Seattle. 914 pp.
- HOLMGREN, A. and N. HOLMGREN. 1977. Poaceae, pp. 175–464. In: Cronquist, A., et al. Intermountain flora. Vol. 6. Columbia University Press, New York. 584 pp.
- MUNZ, P. A. 1968. Supplement to a California flora. Univ. California Press, Berkeley. 224 pp.
- ROTAR, P. P. 1968. Grasses of Hawaii. Univ. Hawaii Press, Honolulu. ix + 335 pp.
- STEYERMARK, J. A. 1963. Flora of Missouri. Iowa State Univ. Press, Ames. lxxxiii + 1728 pp.
- TUTIN, T. G. 1980. Gramineae, pp. 118–267. In: Tutin, T. G., et al., eds. Flora Europaea Vol. 5. Cambridge Univ. Press, Cambridge. 439. pp.
- WEISHAUP, C. G. 1967. Gramineae, pp. 118–267. In: Braun, E. L. The Monocotyledonae [of Ohio]: cat-tails to orchids. Ohio State Univ. Press, Columbus. viii + 464 pp.
- . 1971. Vascular plants of Ohio, ed. 3. Kendall/Hunt Publishing Co., Dubuque. 292 pp.

SOLIDAGO FLACCIDIFOLIA SMALL (ASTERACEAE) NEW TO OKLAHOMA AND OTHER GOLDENROD NOTES—In a loan of unrelated *Solidago* L. specimens from US a specimen of *Solidago flaccidifolia* Small from the Ouachita Mountains appeared: OKLAHOMA: Le Flore Co.: near Page, in open woods on mountain side, 9 Sep 1913, *G. W. Stevens s.n.* (originally misidentified as *Solidago caesia* L.). This is the first report of *S. flaccidifolia* from Oklahoma, and the first west of Louisiana (Cronquist, 1963). Identification was verified by comparison with several herbarium specimens in NCU annotated by Cronquist, with the holotype (NY!), a topotype (US!), and from personal experience with the species in the field.

The arrangement of *Solidago caesia* into a number of varieties by Taylor and Taylor (1983) elicits discussion as the species has not been treated as divisible by other authors since early in the present century. In their arrangement, *Solidago flaccidifolia* is treated as a synonym of the superfluous variety *Solidago caesia* var. *paniculata* Gray. Steyermark (1963) states, under *S. caesia*, "The typical form has the heads in loosely paniculate leafy inflorescences, while the so-called f. *axillaris* (Pursh) House has the heads in simply loose axillary clusters on a simple stem . . . it is not believed that such forms are of any taxonomic value . . .". The type of *Solidago caesia* L. Sp. Pl.: 879. 1753 is based on Dill. elth. 414. f. 395!, an engraving of a

paniculate-corymbose plant, so described by Linnaeus; however, the common phase of *S. caesia* is the simple-stemmed one. In my garden, a simple-stemmed plant of *S. caesia* and one of *Solidago curtisii* T. & G. turned into paniculate ones in a subsequent season. I have never seen *S. flaccidifolia* in any but a simple-stemmed growth habit. It has often been incorrectly dismissed as a "fat"-leaved variant of *S. caesia* or of *S. curtisii*, but it differs from either of the other species as described in Cronquist (1980). In addition to the characters described by Cronquist (l. c.), the involucre bracts of *S. flaccidifolia* are more or less puberulent.

I prefer to retain the name *Solidago curtisii* T. & G. for *Solidago caesia* var. *curtisii* (T. & G.) Wood (Taylor and Taylor, 1983, 1984), in conformity with long-standing majority treatment, because it forms an endemic cohort of the southern Appalachians with well-isolated characters from those of close relative species, so well-documented in the literature that there is no need to reiterate them here. I have, however, noted a character not mentioned in the literature: the leaves of *S. caesia* tend to be yellow-green; those of *S. curtisii* and *S. flaccidifolia* are dark rich green.

The premise of Taylor and Taylor (1983) that *Solidago caesia* var. *hispida* Wood must replace the name *Solidago curtisii* var. *pubens* (Curtis in T. & G.) Gray I believe to be a misapplication. Wood's name, from his Classbook (Ed. 1): 197. 1845, is without type and he describes his taxon as having "a hispid stem and rough leaves". There are no *S. caesia* with such characters, but these are the characters of *Solidago hispida* Muhl., and the Wood name, therefore, is a synonym of that species and should be cited as *Solidago caesia* var. *hispida* (Muhl.) Wood. I believe the Wood combination derives from the unfortunate statement in Pursh, Fl. Amer. Sept.: 541. 1814, that *S. hispida* "resembles no. 33 (*S. caesia*)". Presumably the Pursh Flora was still widely used in 1845. The geography of Wood's first Classbook is largely New York and New England, well out of range of *S. curtisii* var. *pubens*, endemic to the southern Appalachians, a minor variant of *S. curtisii* with puberulent to tomentulose stems, and sometimes leaves, (holotype NY!) which Cronquist (1980) does not even recognize anymore.—Leonard J. Uttal, Department of Biology, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061, U.S.A.

REFERENCES

- CRONQUIST, A. 1963. Manual of vascular plants of northeastern United States and adjacent Canada. D. Van Nostrand Co., Princeton.
 ———. 1980. Vascular flora of the southeastern United States. I. *Asteraceae*. University of North Carolina Press, Chapel Hill.
 STEYERMARK, J. A. 1963. Flora of Missouri. Iowa State University Press, Ames.
 TAYLOR, C. E. and R. J. TAYLOR. 1983. New species, new combinations, and notes on the goldenrods (*Euthamia* and *Solidago*—Asteraceae). *Sida* 10:176–183.
 ———. 1984. *Solidago* (Asteraceae) in Oklahoma and Texas. *Sida* 10:223–251.

NEW ADDITIONS OR OTHERWISE NOTEWORTHY PLANTS OF TEXAS—In Texas, a state with such a wide variety of rainfall, soils and elevation, it is not surprising to find recent plant immigrants naturalizing. The following are new denizens in the Texas flora with the exception of *Euphoria hirta*.

CHORISPORA TENELLA (Pallas) DC. (CRUCIFERAE). Dallam Co.: sandy loam soil near Kerrick, ca 1 mi S of TX-OK line on US 287, 4 May 1980, *L. K. Magrath et al.* 10344 (OCLA, UTEP). Dallas Co.: hwy I-35E and Royal Lane, 15 Apr 1978, *Mitchell* 46 (SMU); near railroad tracks 1 mi E of Royal Lane & I-35E, 9 May 1978, *Doty* 79 (SMU). Deaf Smith Co.: sandy loam roadsides of FM 1259, 15 mi ESE of Hereford, 24 Mar 1967, *Waller* 1272 (SMU). El Paso Co.: sandy roadside, S side of Anthony along US 80-85, 18 Mar 1981, *Worthington* 6906 (SMU, UTEP). A native of Asia, *Chorispora tenella* is now naturalized over much of the United States. Shetler and Skog (1978) do not report it from the Southeast (2) and South Plains (6) regions. Waterfall (1952, 1960) reported it for Oklahoma. It is apparently rare in the southeastern United States: OKLAHOMA. Oklahoma Co.: weed in sandy clay soil along railroad side, 3200 blk of NW 19th street, Oklahoma City, 20 Apr 1940, *Waterfall* 1898 (SMU). LOUISIANA. Caddo Parish: along railroad tracks near center of Kansas City Southern Railroad yard W of LA 173 SE of Blanchard, sec 19, T18N, R14W, 29 May 1979, *Thomas* 65096 (SMU).

COREOPSIS PUBESCENS Elliott var. **PUBESCENS**. (COMPOSITAE). Jasper Co.: edge of logging road ca 7 mi S of Kirbyville, 0.8 mi E of hwy 96 and ca 0.3 mi E of railroad, 15 May 1978, *Ajilvsgi* 7339 (SMU); same locality, 19 Jun 1978, *Ajilvsgi* 5701 (SMU). Although new for Texas, *C. pubescens* was to be expected in the state. Smith (1976) maps collections of *pubescens* in two counties bordering and several others closely bordering Texas in Arkansas, Louisiana and Oklahoma. Identification of specimen was verified by E. B. Smith (UARK).

CORONILLA VARIA L. (LEGUMINOSAE). Montague Co.: sandy roadside ca 1 mi SE of jct of hwy 82 & 287 on 287 S of Bowie, 7 Aug 1983, *Mahler* 9677 (SMU). This species appears to have been introduced as a ground cover for control of soil erosion along new highway construction; it has persisted for three to four years and appears to be well established.

DIANTHUS ARMERIA L. (CARYOPHYLLACEAE). Titus Co.: ca 5 mi E of Talco along hwy 71, 10 May 1977, *Ajilvsgi* 6938 (SMU); just E of overpass S of Winfield along access road to I-30, 15 May 1977, *Ajilvsgi* 6937 (SMU); near I-30 and Loop 360, near public boat ramp sign on W side of Mt. Pleasant, 20 May 1979, *Ajilvsgi* 7286 (SMU). *Dianthus armeria* is a native of Europe.

EUPHORBIA HIRTA L. (EUPHORBIACEAE). Dallas Co.: flower beds

of First City Bank at Josey Lane & Valley View Lane, Farmers Branch [Dallas], 6 Jun 1980, *Lipscomb* 3113 (SMU). The plant was also observed the following year. Correll & Johnston (1970) noted *E. hirta* as a rare waif in coastal south Texas and not persistent.

FATOUA VILLOSA (Thunb.) Nakai (MORACEAE). Bexar Co.: scattered on grounds of San Antonio Botanical Center, 10 Sep 1982, *Lipscomb* 3414 (SMU). Dallas Co.: flower bed of First City Auto Bank, Valley View Lane & Josey Lane, Farmers Branch [Dallas], 31 Jul 1980, *Lipscomb* 3117 (SMU). *Fatoua villosa* is an eastern Asiatic species that was first reported for North America in Louisiana by Thieret (1964). Since then DuQuesnay (1974) and Massey (1975) have reported collections from Alabama, Florida, Georgia, Mississippi, and North Carolina.

HYPERICUM PERFORATUM L. (GUTTIFERAE). Montague Co.: sandy roadside soil ca 1 mi SE of jct of hwy 82 & 287 on 287 S of Bowie, 7 Aug 1983, *Mahler* 9678 (MO, SMU, VDB). Wise Co.: roadside 2.7 mi E of Montague-Wise county line on 287, 16 Jun 1981, *Lipscomb* 3380 (DUR, SMU); 0.5 mi E of Wise-Montague county line on hwy 287, 3 Jul 1983, *Lipscomb* 3419 (SMU). The species is well established along the roadside and has been observed here the last three years. *Hypericum perforatum* is another introduced native of Europe.—*Barney Lipscomb, Herbarium, Southern Methodist University, Dallas, TX 75275, U.S.A.*

REFERENCES

- CORRELL, D. S. and M. C. JOHNSTON. 1970. Manual of the vascular plants of Texas. Texas Research Foundation, Renner.
- DU QUESNAY, D. 1974. *Fatoua villosa* (Moraceae) in Florida. *Sida*: 5:286.
- MASSEY, J. R. 1975. *Fatoua villosa* (Moraceae): additional notes on distribution in the southeastern United States. *Sida* 6:116.
- SHETLER, S. G. and L. E. SKOG (Eds) 1978. A provisional checklist of species of flora North America (revised). *Monogr. Syst. Bot.* 1:1-199.
- SHINNERS, L. H. 1958. Spring flora of the Dallas-Fort Worth area Texas. Published by author, Dallas.
- SMITH, E. B. 1976. A biosystematic survey of *Coreopsis* in eastern United States and Canada. *Sida* 6:123-215.
- THIERET, J. W. 1964. *Fatoua villosa* (Moraceae) in Louisiana: new to North America. *Sida* 1:248.
- WATERFALL, U. T. 1952. A catalogue of the flora of Oklahoma. The Research Foundation, Oklahoma A.&M. College, Stillwater.
- . 1960. Keys to the flora of Oklahoma, Dept. of Botany & Plant Pathology & The Research Foundation, Stillwater.

CORRECTION

The isotypes of *Opuntia beacockae* (Sida 10(3):207–210, 1984) cited for CSU and POM should be CS and POM. Gerald K. Arp.

REVIEW

NATIONAL LIST OF SCIENTIFIC PLANT NAMES. Volume 1—List of Plant Names. 416 pp.; Volume 2—Synonymy. 438 pp. Soil Conservation Service, United States Department of Agriculture, Washington, DC, 1982. Price not given; "available through an interactive terminal from the . . . SCS Integrated Resource Information Systems Staff, Lanham, Md."

North America now has another checklist—the third in 4 years—of plants of a major part of the continent. First was Shetler & Skog, *A Provisional Checklist of Species for Flora North America* (1978). Then came Kartesz & Kartesz, *A Synonymized Checklist of the Vascular Flora of the United States, Canada, and Greenland* (1980). Now appears a ghost-written, two-volume, updated *National List of Scientific Plant Names* (NLSPN) developed by the "Smithsonian Institution" for the Soil Conservation Service, USDA.

The previous (1971) edition of NLSPN has been useful, according to the preface of the new version, for preparers of "technical guides, handbooks, and soil surveys," for abstracters of "research documents," and for coordinators of "plant testing programs among states and regions." The present NLSPN is presumably intended for these persons, too, although the audience at which the work is aimed is nowhere unequivocally stated. The implication is, however, that among this audience are people with limited botanical backgrounds. These persons must find, as I have found, parts of NLSPN difficult or inexplicable.

Volume I: Brief introductory material explains how the two-volume system works and how this list is an expansion of the previous one by the SCS. The user is left guessing as to who at the "Smithsonian" was responsible for developing the work—authorship is not stated although about 220 "taxonomic consultants, reviewers, and contributors" are listed along with names of the taxa for which they are said to have provided data. Further, geographic parameters of the work are not, it seems to me, clearly defined. The word "national" in the title implies the United States, yet on page 5 a map shows the "regions" of North America north of Mexico, including Greenland (region G) and Canada (divided into five regions). On page i of volume 1 is written: "The revised NLSPN differs from the previous list in that it has been divided into three lists of accepted names, one each for the Caribbean region, Hawaii, and the 49 continental United States and

Canada." From this statement I wondered if NLSPN includes all Canadian plants or only those represented also in the United States. Noting no basic Canadian works among the "source manuals" the consultants used, I checked NLSPN to determine if it lists any Canadian species that do *not* get into the United States. Apparently not.

On pages 2 and 3 is a list of about 50 "source manuals," mostly checklists and floras. None of these is from the 1980s; most are from the 1970s; a few date back to the 1920s and 1930s (including the 1936 Hitchcock West Indian grass manual—the U. S. manual is not listed). No *taxonomic monographs* and only a few journal articles are represented; even the Shetler & Skog and Kartesz & Kartesz checklists are absent. And yet these "source manuals" are said to be "*all major sources that the consultants used*" [emphasis mine]. I find it impossible to believe that an accurate and up-to-date checklist of the US flora could be compiled from such a data base.

Most of the volume is given over to lists of taxa that constitute the flora of each of the work's three sections. The data for each infrageneric taxon include: a four- to six-character nameber (e.g., EPVI2 for *Epifagus virginiana*); the scientific name and authority(ies); the "source manuals"; habit (i.e., whether annual, biennial, submersed, succulent, grasslike, tree, native, introduced, etc.); distribution (by numbers of the 20 regions outlined in the map on page 5); and family name and number.

On pages 7 through 20 is a "Guide to Family Numbers" used in the work, i.e., an alphabetical list of genera, each name followed by its family number. The listing is not of "accepted" names only but includes synonyms as well. The synonyms must be sought in volume 2, the synonymy volume, but the listing provides no way to distinguish synonyms from "accepted" names. Thus, the seeker of a name—for example, *Moluchia*—must first look up the name in the "Guide," which refers him to family 198, Sterculiaceae. Then he must look through the three sections of volume 1 and, that being fruitless, must then turn to volume 2 to learn what *Moluchia* is a synonym of.

Among the puzzling parts of the volume are the listed names of plants that I believe are not known to occur, either native or naturalized, in the United States, e.g., in Meliaceae (*Aphanamixis grandifolia*, *Entandrophragma delevoiyi*, *Khaya nyasica*, *Khaya senegalensis*, *Toona ciliata* var. *australis*), Fagaceae (*Quercus suber*), Malpighiaceae (*Hiraea faginea*), and Proteaceae (*Macadamia ternifolia*) (distributional data are not given for many of these taxa, an omission [?] that is not explained). No documented records exist, to my knowledge, of such plants growing in the United States outside of cultivation. Another example: NLSPN lists 55 species under *Digitaria* (Hitchcock includes only 20; Shetler & Skog, 24; Kartesz & Kartesz, 35); at least one-third of these are not known to me as native or naturalized plants in our flora. Does this mean that NLSPN also includes some cultivated plants?

The literature search on which NLSPN was based seems to have been somewhat casual—a number of published and easily accessible records for the US flora were missed. Among these are: *Amphibromus scabrivalvis*, *Arctostaphylos luciana*, *A. purissima*, *Blyxa aubertii*, *Brodiaea elegans* ssp. *hooveri*, *Clinopodium gracile*, *Cyperus grayioides*, *C. louisianensis*, *Fatoua villosa*, *Gisekia pharnacioides*, *Glandularia chiricahensis*, *G. vercunda*, *Lilium fairchildii*, *Limnophila* X *ludoviciana*, *Lindera melissifolium*, *Lysimachia japonica*, *Oxypolis greenmanii*, *Physalis lagascae*, *Rumex obovatus*, *R. paraguayensis*, *Salsola soda*, *Scutellaria thieretii*, and *Striga gesnerioides*.

The author citations used in the work essentially follow existing floras with some modifications. On page 2 under "Author," the following is stated: "An asterisk following an author means that the Smithsonian Institution studied the original description fully enough to confirm that it is accurately cited. . . ." However, there are some asterisked—and thus "studied"—citations where "zoological style" and not botanical style of authorship is presented—e.g., "*Cirsium griseum* (Rydb.)*," *Cirsium quercetorum* var. "*walkeranum* (Petrak)*," and *Rudbeckia fulgida* var. "*spathulata* (Michx.)*." Far worse is the listing of infraspecific entries in which the epithet is given as ssp. *genuinum* or as var. *genuinum*, both with an author citation, e.g., *Polemonium viscosum* ssp. *genuinum* Wherry and *Sicyos laciniatus* var. *genuinum* Cogn.

Perhaps the most significant botanical blunder is the double entries in both nomenclatural and taxonomic synonyms, with more of the former than the latter. Although I have casually examined only about half of volume 1, I found many such entries, each of the two synonyms appearing as an "accepted name." A sample of the nomenclatural synonyms follows: *Baptisia australis* var. *minor* & *B. minor*, *Calamagrostis gigantea* & *Calamovilfa gigantea*, *Castilleja gleasonii* & *C. pruinosa* ssp. *gleasonii*, *Cercocarpus betuloides* var. *macrourus* & *C. montanus* var. *macrourus*, *Cleome isomeris* & *Isomeris arborea*, *Cryptantha grandiflora* & *C. intermedia* var. *grandiflora*, *Cymbalaria muralis* & *Linaria cymbalaria*, *Elymus hirtiflorus* & *Agroelymus hirtiflorus*, *Elymus piperi* & *Elyhordeum piperi*, *Krameria glandulosa* & *K. parvifolia* var. *glandulosa*, *Micropyxis pumila* & *Anagallis pumila*, *Panicum tuckermanii* & *P. philadelphicum* var. *tuckermanii*, and *Sphenopholis pensylvanica* & *Trisetum pensylvanicum*.

No less embarrassing than double entries are alternative spellings of the same specific epithet in different "accepted" taxa—e.g., *Gelsemium rankii* Small treated as distinct from *Gelsemium rankinii* Small and *Lycopus virginicus* L. treated as distinct from *Lycopus virginiana* L. One also finds the same binomials credited to different authors and listed separately—e.g., *Cleome speciosa* H.B.K. non Raf. and *Cleome speciosa* Raf.; *Rhynchospora*

pusilla Chapm. ex M. A. Curt. and *R. pusilla* (Swartz) Griseb. non Chapm. ex M. A. Curtis (both names with an asterisk!); and *Hyptis americana* Aubl. and *Hyptis americana* (Poir.) Briq. Also included are a number of binomials that have never been validly published (e.g., in *Eriogonum*); these are presented without any indication of "ined."

Nowhere in the volume have I noted a "typical" variety or subspecies indicated by a repetition of the specific epithet with no author citation. For example, the names in the two-line listing of *Calamovilfa longifolia* are:

C. LONGIFOLIA (Hook.) Scribn.
[var.] MAGNA Scribn. & Merrill

From the indicated distribution of these taxa it is evident that "*C. longifolia* (Hook.) Scribn." is meant to be "*C. longifolia* var. *longifolia*." Then there are similar entries in which no distributional data at all are given for the taxon under which appear infraspecific names, e.g., *Arabis hirsuta*, *Carex lasiocarpa*, *Juncus acutus*, and *Polygonum meisnerianum*. This indicates that the "typical" variety or subspecies is not in the geographic area covered by NLSPN, a subtlety of format that may be confusing to users of this work who have limited botanical backgrounds.

Another kind of problem can be seen in the Verbenaceae, where NLSPN inexplicably segregates only a single species of *Glandularia* from *Verbena* when indeed a number of additional species should be split therefrom if one recognizes *Glandularia*. A similar situation exists—i.e., the incomplete removal of species from an inclusive to a segregate genus—for *Mahonia* and *Berberis*, *Desmodium* and *Meibomia*, and others.

Volume 2: The synonymy volume lists, in alphabetical order, "names . . . that have been incorrectly used," indicating after each name the "accepted" (or "preferred") name under which the taxon is entered in volume 1. Much of the synonymy is straightforward, but the going gets rough with certain of the eight different symbols that are used to "clarify further the relationship of plant names and their synonyms." I for one am left bewildered by these and can not imagine how the originators of NLSPN could possibly expect range biologists and soil survey workers—and others whose forte is not nomenclature—to understand them.

For example, under *Cyanococcus liparus*, three of the eight symbols are represented. These three are explained thus (page 2):

N—Some sources or consultants believe the name above the sign has been misapplied to the name after it.

>—One or more sources have used the name above the sign to include plants covered by other sources' descriptions for the name following the sign.

(—The name above this symbol has a type that is included in the descrip-

tion of the following name. A name preceding this sign cannot be an accepted name.

Under *Cyanococcus liparus* the following appears:

CYANOCOCCUS LIPARUS

- N > *Vaccinium caesariense*
- N > *Vaccinium corymbosum*
- (*Vaccinium pallidum*

The three *Vaccinium* names are treated as distinct species in volume 1, while I still am wondering what to do with *C. liparus*.

Further puzzlement in the synonymy volume is provided by the including therein, without species under them, of generic names that are the correct names, e.g., *Limnobium*, *Limnophila*, *Liparis*, *Lipocarpha*, *Liquidambar*, *Liriodendron*, *Lithophila*, and *Litsea*, to mention just a few among the Ls. The names appear again in volume 1, both in the "Guide to family numbers" and in at least one of the three regional lists. I cannot explain this repetitive listing.

The user of NLSPN, noting such examples as above described and struggling to decide where careless or enigmatic work ends and careful, lucid work begins, is left to wonder what went wrong. The poorly done parts of NLSPN cast a shadow of a doubt, of course, on the well done parts.

Comparison of NLSPN with Kartesz & Kartesz (KK) is inevitable (Shetler & Skog contains no synonymy and is thus in a class by itself). Between NLSPN and KK, my choice is unhesitatingly KK, which is easier to use—only one volume, with synonyms listed immediately after each correct name—and is a more carefully prepared and thus more reliable work. However, one point in favor of NLSPN is that one can tell from it whether a species occurs in continental U.S. or the Caribbean Region or Hawaii; such cannot be determined from KK, which includes these plus Canada but does not distinguish among them.

The review copy is already falling apart (a perfect binding for an imperfect product).—*John W. Thieret, Northern Kentucky University, Highland Heights, KY 41076, U.S.A.*

REVIEWERS FOR VOLUME 10 OF SIDA

The following individuals kindly provided time and energy in reviewing manuscripts published in SIDA.

Daniel F. Austin	Robert Kral
T. M. Barkley	James A. Lackey
Rupert Barneby	Thomas G. Lammers
Lincoln Constance	Lawrence K. Magrath
Donovan S. Correll	Max E. Medley
Helen B. Correll	Guy L. Nesom
Arthur Cronquist	Dan H. Nicolson
H. R. DeSelm	Richard W. Pohl
James W. Hardin	Reed C. Rollins
Stephan L. Hatch	Edwin B. Smith
William J. Hess	Richard W. Spellenberg
Duane Isely	Ronald L. Stuckey
Almut G. Jones	Rolla Tryon
Tetsuo Koyama	Gary Tucker

Wm. F. Mahler, Publisher

Barney L. Lipscomb, Editor

John W. Thieret, Associate Editor

SIDA CONTRIBUTIONS TO BOTANY

INDEX TO VOLUME 10

Names of contributing authors are in CAPITAL letters. New names and combinations are in **boldface**.

- Abdulmajidia 96
 Acer spicatum 119
 A comparison of *Poa tracyi* and *Poa occidentalis* (Poaceae:Poaceae) by Robert J. Soreng and Stephan L. Hatch 123-141
 Acsmithia 96
 Aira caryophyllea 263
 Albertokuntzea 96
 Alexgeorgia 96
 Allanblackia 96
 ALLEN, CHARLES M., *Murdannia keisak* (Hassk). Hand.-Mazz. (Commelinaceae), *Bothriochloa hybrida* (Gould) Gould (Poaceae), and *Scutellaria racemosa* Pers (Lamiaceae) new to Louisiana 189-190
 Allenrolfea 96
 Allium burdickii 116
 Alopecurus pratensis 115
 Amaranthus palmeri 117
 Amianthium muscaetoxicum 116
 Amolinia 96
 An addition to the New Mexico Flora, *Glossopetalon planitierum* (Crossosmataceae) by Ralph E. Brooks 321-322
 ANDERSON, LORAN C., Noteworthy plants from north Florida 295-297
 ANDERSON, LORAN C., Trichomes and stomata of *Gordonia lasianthus* (Theaceae) 103-113
 A new combination in the Poaceae by Stephan L. Hatch 321
 A new species of *Nymphaea* (Nymphaeaceae) from the Amazon Basin by John H. Wiersema 195-198
 A new species of *Rhodopis* (Fabaceae) from Hispaniola by Walter S. Judd 203-206
 A new variety of *Dalea eriophylla* S. Wats (Leguminosae-Amorpheae) from Sierra Madre Oriental by R. C. Barneby 14
 Apera interrupta 322, 323
 Application of the names *Verbesina mollsi* and *Verbesina sericea* (Compositae:Heliantheae) by Neil A. Harriman 24-29
 Arabis canadensis 295
 Arnoglossum sulcatum 258
 Arnoglossum sulcatum (Asteraceae) in Mississippi by Will W. McDearman 258-259
 Arnoldoschultzea 96
 Aronia arbutifolia forma **glabra** 199; medikus 199; melanocarpa 200; × prunifolia 202
 ARP, GERALD K., *Opuntia heacockae* (Cactaceae) a new species from central Colorado 207-210
 Arthraxon hispidus 115
 Asclepias viridiflora 295
 Aster 41; fontinalis 295; georgianus 65; patens var. gracilis 72; var. patens 71; var. patentiissimus 75; phlogifolius 69, 295; pratensis 188; shortii 295; simplex 295; tataricus 121
 A systematic study of *Aster* section *Patentes* (Asteraceae) by Ronald L. Jones 41-81
 Ayena euphrasiifolia 17
 BACON, JOHN D., Chromosome numbers and taxonomic notes in the genus *Nama* (Hydrophyllaceae). II 269-275
 Barkerwebbia 96
 BARNEBY, R. C., A new variety of *Dalea eriophylla* S. Wats. (Leguminosae-Amorpheae) from Sierra Madre Oriental 14
 BEARDEN, DAVID A., see Hatch 184-187
 Billieturnera 96
 Biosystematic study and typification of the Californian *Coreopsis* (Compositae) sections *Tuckermannia*, *Pugiopappus*, and *Euleptosyne* by Ed-

- win B. Smith 276–289
Blumea viscosa 30
Bothriochloa edwardsiana 261; hybrida 190
Botrychium jenmannii 295
 BRANDENBURG, DAVID M., see Cusick 322–323
Bromus sterilis 257; *tectorum* 296
Bromus sterilis L. (Poaceae) new to Texas by Steven D. Warren and Stephan L. Hatch 257–258
 BROOKS, RALPH E., An addition to the New Mexico flora, *Glossopetalon planitierum* (Crossosmataceae) 321–322
 BROWN, LARRY E., *Carex rosea* (Cyperaceae), *Trifolium lappaceum* (Fabaceae) and *Aira caryophyllea* new to Texas 263–264
 BROWN, LARRY E., see Kessler 322
Burttidavya 96
Caltha palustris 117
Camelina microcarpa 118
Campanula rapunculoides 121
Captaincookia 96
Carex gigantea 291, 293; *glaucescens* 291; *joorii* 115, 291; *laxiculmis* 116; *rosea* 263; *Carex rosea* (Cyperaceae), *Trifolium lappaceum* (Fabaceae) and *Aira caryophyllea* (Poaceae) new to Texas by Larry E. Brown and Charles D. Peterson 263–264
Carlomohria 96
Carlostephania 96
Carlowrightia 96
Carolofritschia 96
Caroli-Gmelina 96
Carya pallida 255
Carya pallida (Ashe) Engl. & Graebn. (Juglandaceae), a new Arkansas record by T. E. Heineke 255–256
Cayaponia grandiflora 296
Cecarria 96
Centaurea cyanus 296
Ceratophyllum muricatum 117
 CHESTER, EDWARD W., *Echinodorus tenellus* var. *parvulus* (Alismataceae) in Kentucky 262–263
Chiococca alba 296
Chorisporea tenella 326
 Chromosome numbers and taxonomic notes in the genus *Nama* (Hydrophyllaceae). II by John D. Bacon 269–275
Chrysosplenium americanum 118
 Cleistogamy in *Muhlenbergia cuspidata* (Poaceae) by Clifford W. Morden and Stephan L. Hatch 254–255
Clematis terniflora 117
Conyza chiapensis 192
Coreopsis 276; *bigelovii* 283; *californica* var. *californica* 286; var. *newberryi* 287; *calliopsidea* 282; *douglasii* 286; *gigantea* 281; *hamiltonii* 284; *maritima* 282; *pubescens* var. *pubescens* 326; var. *robusta* 296; *stillmanii* 285
Coronilla varia 326
 CRANFILL, RAY, see Medley 114–122
Crepis capillaris 121
 CREWZ, DAVID, see Fryxell 319–320
 CUSICK, ALLISON W., Two adventive species of grasses, *Apera interrupta* and *Deschampsia danthonioides* (Poaceae), new to the Ohio flora 322–323
Cymbalaria muralis 120
Cynanchium scoparium 296
Cynoctonum mitreola 291
 Cyperaceae new to Texas and Louisiana by James W. Kessler and Tom Starbuck 190–191
Cyperus acicularis 303; *albomarginatus* 291; **correllii** 305; *eggersii* 303; *engelmannii*; *filicinus* 291; *haspan* 291; *macrocephalus* 303; *manimae* 302; *odoratus* 303, 306; *ovularis* var. *cylindricus* 258
Cyperus ovularis (Michx.) Torr. var. *cylindricus* (Ell.) Torr. (Cyperaceae) new to New Mexico by James W. Kessler 258
Cypripedium candidum 189
Cypripedium candidum Muhl. ex Willd. (Orchidaceae) in Arkansas by Edwin B. Smith 189
Cyrlwhitea 97
Dalea eriophylla var. **uniflora** 14
 Davis, Richard Harley, 1946–1983, In Memoriam by Gary Tucker 265–267
Deschampsia danthonioides 322, 323
Descurainia sophia 118
Desmodium canescens 296; *glabellum* 142; *paniculatum* 142; *perplexum* 142
Dianthus armeria 326
Dionaea muscipula 296
Donnellsmithia 97
 DORR, LAURENCE J., Lectotypification of *Verbesina texana* Buckl.

- (Asteraceae); A correction 82–85
Drosera brevifolia 118; *intermedia* 118
Duranta 308; *arida* 315; *armata* 315;
cajamaricensis 315; *costaricensis* 314;
dombeyana 314; × *mandonii* 317;
 × *mandonii* 317; × *mutisii* 317;
 × *tricantha* 317; *fischeri* 317; *guate-*
malensis 314; *joergensenii* 317; *man-*
donii 314; × *triacantha* 316; *mutisii*
 313; × *armata* 316; × *sprucei* 316;
 × *triacantha* 316; *obtusifolia* 313;
 × *mandonii* 315; × *mutisii* 315;
 × *triacantha* 316; × *sprucei* 316;
pearcei 317; *peruviana* 313; *repens*
 311; 'Alba' 313; × *arida* 315; ×
costaricensis 315; 'Grandiflora' 313;
 'Macrodonia' 313; × *vestita* 315;
serratifolia 313; × *sprucei* 316;
sprucei 314; × *armata* 316; × *tria-*
cantha 316; *stenostachya* 313; *tria-*
cantha 314; *vestita* 314; *woronowii*
 313
Echinodorus tenellus var. *parvulus* 262
Echinodorus tenellus var. *parvulus* (Alis-
 mataceae) in Kentucky by Edward W.
 Chester and Kevin Souza 262–263
Edbakeria 97
Edithcolea 97
Eduardoregelia 97
Eleocharis baldwinii 291, 292; *fallax*
 291; *microcarpa* 291; *tuberculosa*
 291; *vivipara* 190
Elidurandia 97
Ellisia myctelea 120
Elmerrillia 97
Enriquebeltrania 97
Eragrostis unioloides 85
Erianthus strictus 291
Erigeron concinnus 159; var. *concinnus*
 164; var. *condensatus* 165; var.
subglaber 165; *pumilus* 159
Eriocaulon lineare 296
Eriogonum longifolium var. *harperi* 117
Ernestimeyera 97
Euonymus alatus 119
Eupatorium mohrii 37; *quinqueflorum*
 37
Eupatorium mohrii, a new record for
 the Dominican Republic, including
E. quinqueflorum, Syn. Nov. (Aster-
 aceae) by Victoria I. Sullivan 37–40
Euphorbia hirta 327
Euthamia 176; *graminifolia* var. **hir-**
tipes 176; *tenuifolia* var. **pycno-**
cephala 177
Fatoua villosa 327
Firmiana simplex 16
Foriestiera segregata 296
 FRYXELL, PAUL A., *Sidus Sidarum*—
 IV. A new record of *Sida* in North
 America, *S. santaremensis* (Mal-
 vaceae) 319–320
 FRYXELL, PAUL A., Very personal
 generic names (*Nomina Perpropria*):
 A contribution to whimsical botany
 95–102
Galium mollugo 120
Gaylussacia dumosa 291
 Geiser, Samuel Wood, In Memoriam
 192–193
Geum laciniatum 118
Glossopetalon planitierum 321
Glyceria striata 259
Gordonia lasianthus 103
Gymnopogon brevifolius 115
 HARDIN, JAMES W., The demoulin
 rule in nomenclature 252
Harlanlewisia 97
 HARRIMAN, NEIL A., Application of
 the names *Verbesina mollis* and *Ver-*
besina sericea (Compositae: Helian-
 theae) 24–29
 HARRIMAN, NEIL A., Newly adven-
 tive grasses in the flora of Trinidad
 85–86
Harrysmithia 97
 HARVILL, A. M. JR., On the history
 of coastal plain species on the Cum-
 berland Plateau and Highland Rim
 290–294
 HATCH, STEPHAN L., A new combi-
 nation in the Poaceae 321
 HATCH, STEPHAN L., see Morden
 254–255
 HATCH, STEPHAN L., see R., Valdes
 J. 259–262
 HATCH, STEPHAN L., see Soreng
 123–141
 HATCH, STEPHAN L., see Warren
 257–258
 HATCH, STEPHAN L., *Stipa curifolia*
 (Poaceae)—studies on a rare taxon
 184–187
 HEINEKE, T. E., *Carya pallida* (Ashe)
 Engl. & Graebn. (Juglandaceae), a
 new Arkansas record 255–256

- Heliabravoa* 97
Helianthus atrorubens 296
Henribaillonia 97
Heracleum lanatum 119
Hexastylis contracta 117
Hymenoxys texana 87
Hypericum nudiflorum 291; *perforatum* 327
Ifdregea 97
Ipomoea dumetorum 252; *hederacea* var. *integriuscula* 296
Ipomoea dumetorum (Convolvulaceae): an amphitropical disjunct morning glory in the southwest U.S. by Andrew McDonald 252-254
Iris prismatica 291
Irvingbaileya 97
Ischaemum indicum 86
ISELY, DUANE, The *Desmodium paniculatum* (L.) DC. (Fabaceae) complex revisited 142-158
Isidrogalvia 97
Ivanjohnstonia 97
Jacqueshuberia 97
Jamesbrittenia 97
Jarandersonia 97
Joannegria 97
Johnannesteijsmannia 98
JONES, RONALD L., A systematic study of *Aster* section *Patentes* (Asteraceae) 41-81
JUDD, WALTER S., A new species of *Rhodopis* (Fabaceae) from Hispaniola 203-206
JUDD, WALTER S., The taxonomic status of *Stipulicida filiformis* (Caryophyllaceae) 33-36
Juncus dudleyi 116; *elliottii* 291; *interior* 116; *secundus* 116
Juttadinteria 98
KESSLER, JAMES W., Cyperaceae new to Texas and Louisiana 190-191
KESSLER, JAMES W., *Cyperus ovularis* (Michx.) Torr. var. *cylindricus* (Ell.) Torr. (Cyperaceae) new to New Mexico 258
KESSLER, JAMES W., Range extensions for Cyperaceae in Louisiana and Texas 92
KESSLER, JAMES W., *Scirpus cernuus* Vahl. var. *californicus* (Torr.) Beetle (Cyperaceae) new to Texas 322
Kingdon-Wardia 98
KRAPOVICKAS, ANTONIO, see Fryxell 319-320
Lactuca serriola 296
LAMMERS, THOMAS G., *Stylisma pickeringii* var. *pattersonii* (Fern. & Schub.) Myint (Convolvulaceae) re-discovered in Iowa 256-257
Lectotypification of *Verbesina texana* Buckl. (Asteraceae): A correction by Laurence J. Dorr and John Olsen 82-85
Lenbarassia 98
Leptoloma cognatum 115
Lesquerella gracilis 168; *pallida* 167, 171
Leucothoe recurva 119
LIPSCOMB, BARNEY L., New additions or otherwise noteworthy plants of Texas 326-327
LIPSCOMB, BARNEY L., see Nixon 167-175
Ludwigia hirtella 291
Lycopodium alopercuroides 291
MC DONALD, ANDREW, *Ipomoea dumetorum* (Convolvulaceae): an amphitropical disjunct morning glory in the southwest U.S. 252-254
MC DEARMAN, WILL W., *Arnoglossum sulcatum* (Asteraceae) in Mississippi 258-259
Magnolia pyramidata 118
Machaeranthera aurea 87
MAHLER, WM. F., Rediscovery of *Hymenoxys texana* and notes on two other Texas endemics 87-92
MAHLER, WM. F., The grasses of Baja California Mexico, a review 92-93
MAHLER, WM. F., The role of plant succession in the extinction of plant species 191
Marshallfieldia 98
Matalea carolinensis 120
Maxburretia 98
Mecardonia acuminata 120
MEDLEY, MAX E., Vascular flora of Kentucky: additions and other noteworthy collections 114-122
Melochia corchorifolia 19; *pyramidata* 22; *tomentosa* 21 *villosa* 19
Metcalfia mexicana 260
MORDEN, CLIFFORD W., Cleistogamy in *Muhlenbergia cuspidata* (Poaceae) 254-255
Muhlenbergia cuspidata 254; *torreyana* 291

- Murdannia keisak* 116, 189
Murdannia keisak (Hassk.) Hand.-Mazz. (Commelinaceae), *Bothriochloa hybrida* (Gould) Gould (Poaceae), and *Scutellaria racemosa* Pers. (Lamiaceae) new to Louisiana by Charles M. Allen 189–190
Myrsine guianensis 296
Nama 269; *aretioides* 271; *biflorum* 271; *canescens* 271; *carnosum* 271; *coulteri* 271; *demissum* var. *demissum* 271; *demissum* var. *deserti* 271; *densum* 271; *depressum* 271; *dichotomum* var. *chasmogamum* 271; var. *dichotomum* 271; var. *pueblense* 271; *flavescens* 271; *hirsutum* 272; *hispidum* var. *mentzelii* 272; var. *sonorae* 272; *hitchcockii* 272; *jamaicense* 272; *lobbii* 272; *organifolium* var. *organifolium* 272; *palmeri* var. *palmeri* 272; *parviflorum* 272; *parvifolium* 272; *pringlei* 272; *propinquum* 272; *prostratum* 22; *pusillum* 272; *retrosum* 272; *rothrockii* 272; *rotundifolium* 272; *sandwicense* 273; *sericeum* 273; *serpylloides* var. *confertum* 273; var. *velutinum* 273; *stevensii* var. *gypsicola* 273; var. *stevensii* 273; *turneri* 273; *undulatum* var. *undulatum* 273; *xylopodium* 273
Nebrownia 98
 NESOM, GUY L., Taxonomy of *Erigeron concinnus* (Asteraceae) and its separation from *E. pumilus* 159–166
 NESOM, GUY L., The evolutionary origin of *Blumea viscosa* (Asteraceae) and a first report from North America 30–32
 New additions or otherwise noteworthy plants of Texas by Barney L. Lipscomb 326–327
 New grass (Poaceae) distribution records for Mexico by Jesus Valdes R. and Stephan L. Hatch 259–262
 Newly adventive grasses in the flora of Trinidad by Neil A. Harriman 85–86
 New species, new combinations and notes on the goldenrods (*Euthamia* and *Solidago*—Asteraceae) by Constance E. S. Taylor and R. John Taylor 176–183
 NIXON, ELRAY S., Rediscovery of *Lesquerella pallida* (Cruciferae) 167–175
 Nomenclatorial changes, lectotypification, and comments in *Aronia medikus* (Rosaceae) by Leonard J. Uttal 199–202
Normanbokea 98
 Noteworthy plants from north Florida by Loran C. Anderson 295–297
Nymphaea potamophila 195
Nymphoides peltata 120
Oakes-Amesia 98
 OLSEN, JOHN, see Dorr 82–85
 On the history of coastal plain species on the Cumberland Plateau and Highland Rim by A. M. Harvill, Jr.
Opuntia heacockae 207, 328
Opuntia heacockae (Cactaceae) a new species from central Colorado by Gerald K. Arp 207–210
Orobanche ramosa 120; *uniflora* 296
Ottoschmidtia 98
Ottoschulzia 98
Ottosonderia 98
Palmervandenbroeckia 98
Panicum ramosum 296; *sphaerocarpon* var. *polyanthes* 191; *texanum* 115
Panicum sphaerocarpon Ell. var. *polyanthes* (Schultes) A. S. Sherif (Poaceae) comb. nov. by A. S. Sherif 191
Pappophorum vaginatum 261
Parietaria floridana 296
Parnassia asarifolia 118; *grandifolia* 118
Passiflora suberosa 296
Pauladolphia 98
Paulomagnusia 98
Paulo-wilhelmia 98
Pectis prostrata 296
Pereilema crinitum 261
Peteravenia 98
 PETERSON, CHARLES D., see Brown 263–264
Phlox glaberrima 297
 Phylogenetic trees in plant systematics by Tod F. Stuessy 1–13
Plarodrigoa 98
Platanthera cristata 116; *psycodes* 116
Poa curta 136; *leptocoma* 136 *occidentalis* 123, 136; *reflexa* 136; *tracyi* 123, 138
Polygonella americana 291
 Provisional synopsis of the species and natural hybrids in *Duranta* (Verbenaceae) by Roger W. Sanders 308–318

- Pyracantha koidzumii* 297
Radyera 98
Rahowardiana 99
 Range extensions for Cyperaceae in Louisiana and Texas by James W. Kessler 92
Raulinoreitzia 99
 Rediscovery of *Hymenoxys texana* and notes on two other Texas endemics by Wm. F. Mahler 87–92
 Rediscovery of *Lesquerella pallida* (Cruciferae) by Elray S. Nixon, John R. Ward and Barney L. Lipscomb 167–175
Reedrollinsia 99
 REEVES, TIMOTHY, see Smith 211–215
 Review: National list of scientific plant names by John W. Thieret 328–332
Rhamnus frangula 119
Rhododendron minus 120
Rhodopis lowdenii 203; *planisiliqua* 205
Rhodotypos scandens 119
Rhynchosia tomentosa 119
Rhynchospora caduca 291; *chalarocephala* 291; *corniculata* 291; *debilis* 291; *perplexa* 291; *rarifolia* 291
Romanschulzia 99
Rorippa austriaca 118
Rosa bracteata 297
Roystonea 99
 R., VALDES JESUS, New grass (Poaceae) distribution records for Mexico 259–262
Salsola kali 117
Salvinia minima 297
 SANDERS, ROGER W., Provisional synopsis of the species and natural hybrids in *Duranta* (Verbenaceae) 308–318
Sanguisorba canadensis 119
Schizachyrium sanguineum var. **hirtiflorum** 321; var. *oligostachyum* 261
Scirpus cernuus var. *californicus* 322; *divaricatus* 291
Scirpus cernuus Vahl var. *californicus* (Torr.) Beetle (Cyperaceae) new to Texas by James W. Kessler and Larry E. Brown 322
Scleria lithosperma 190
Scutellaria drummondii 297; *racemosa* 190
Sebastiano-schaueria 99
Sedum acre 118
Selaginella gypsophila 211
Selaginella gypsophila (Selaginellaceae), yet another new edaphic endemic from northern Mexico by Alan R. Smith and Timothy Reeves 211–215
Senecio memmingeri 216, 220; *millefolium* 216, 217
Senecio millefolium T. & G. (Asteraceae) and its introgressants by Leonard J. Uttal 216–222
Sesbania virgata 297
 SHERIF, A. S., *Panicum sphaerocarpon* Ell. var. *polyanthes* (Schultes) A. S. Sherif (Poaceae) comb. nov. 191
Sida santaremensis 319, 320
Sidus Sidarum—IV. A new record of *Sida* in North America, *S. santaremensis* (Malvaceae) by Paul A. Fryxell, Antonio Krapovickas and David Crewz 319–320
Sinowilsonia 99
Sirhookera 99
 SMITH, ALAN R., *Selaginella gypsophila* (Selaginellaceae), yet another new edaphic endemic from northern Mexico 211–215
 SMITH, EDWIN B., *Cypripedium candidum* Muhl. ex Willd. (Orchidaceae) in Arkansas 189
 SMITH, EDWIN B., Biosystematic study and typification of the Californian *Coreopsis* (Compositae) sections *Tuckermannia*, *Pugiopappus*, and *Euleptosyne* 276–289
Solidago (Asteraceae) in Oklahoma and Texas by Constance E. S. Taylor and R. John Taylor 223–251
Solidago flaccidifolia Small (Asteraceae) new to Oklahoma and other goldenrod notes by Leonard J. Uttal 324–326
Solidago 176, 223; **altiplanities** 178, 227; *arguta* var. *boottii* 227; *auriculata* 228; *bigelovii* 182, 183; *caesia* 324; var. *caesia* 181, 228; var. **curtisii** 181, 230; var. *hispida* 182, 250; var. *paniculata* 182; *canadensis* var. *gilvocanescens* 230; var. *hargerii* 231; var. *salebrosa* 231; var. *scabra* 231; *curtisii* 325; *flaccidifolia* 250, 297, 324; *flexicaulis* 250; *gigantea*

- 232; var. *serotina* 232; *hispida* 234, 325; *missouriensis* var. *fasciculata* 234; var. **tenuissima** 182; *mollis* var. *angustata* 235; var. *mollis* 235; *nemoralis* var. *longipetiolata* 236; var. *nemoralis* 235; *nitida* 236; *odora* 238; *petiolaris* var. *angusta* 238; var. *petiolaris* 238; *ptarmicoides* 239; *radula* 239; *rigida* 239; *rugosa* var. *aspera* 242; var. *rugosa* 240; *salicina* 242; *sempervirens* var. *Mexicana* 243; var. *sempervirens* 243; *speciosa* var. *rigidiuscula* 244; var. *speciosa* 243; *stricta* 245; *tortifolia* 245; *ulmifolia* var. *microphylla* 246; var. *ulmifolia* 246; *velutina* var. **nevadensis** 246; *wrightii* 182; var. *adenophora* 183, 250; var. *wrightii* 248
- SORENG, ROBERT J., A Comparison of *Poa tracyi* and *Poa occidentalis* (Poaceae:Poaceae) 123–141
- SOUZA, KEVIN, see Chester 262–263
- Sporobolus asper* 261; *juncus* 188; *spiciformis* 261
- STARBUCK, TOM, see Kessler 190–191
- Stellaria aquatica* 117
- Stipa curvifolia* 184; *ichu* 259; *lobata* 260 *neomexicana* 260; *occidentalis* 184
- Stipa curvifolia* (Poaceae)—studies on a rare taxon by Stephan L. Hatch and David A. Bearden 184–187
- Stipulicida filiformis* 33
- STUESSY, TOD F., Phylogenetic trees in plant systematics 1–12
- Stylisma pickeringii* var. *pattersonii* 256
- Stylisma pickeringii* var. *pattersonii* (Fern. & Schub.) Myint (Convolvulaceae) rediscovered in Iowa by Thomas G. Lammers 256–257
- SULLIVAN, VICTORIA I., *Eupatorium mohrii*, a new record for the Dominican Republic including *E. quinqueflorum*, Syn. Nov. (Asteraceae) 37–40
- SUNDELL, ERIC, Two additions to the Arkansas flora from Warren Prairie 188–189
- Svenhedinia* 99
- Taxonomic notes on two common neotropical species of *Cyperus* (Cyperaceae) by Gordon C. Tucker 298–307
- Taxonomy of *Erigeron concinnus* (Asteraceae) and its separation from *E. pumilus* by Guy L. Nesom 159–166
- TAYLOR, CONSTANCE E. S., *Solidago* (Asteraceae) in Oklahoma and Texas 223–251
- TAYLOR, CONSTANCE E. S., New species, new combinations and notes on the goldenrods (*Euthamia* and *Solidago*—Asteraceae) 176–183
- TAYLOR, R. JOHN, see Taylor, C.E.S. 223–251
- TAYLOR, R. JOHN, see Taylor, C.E.S. 176–183
- Thalictrum texanum* 89, 91
- The demoulin rule in nomenclature by James W. Hardin 252
- The *Desmodium paniculatum* (L.) DC. (Fabaceae) complex revisited by Duane Isely 142–158
- The grasses of Baja California, Mexico, a review by Wm. F. Mahler 92–93
- The evolutionary origin of *Blumea viscosa* (Asteraceae) and a first report from North America by Guy L. Nesom 30–32
- The role of plant succession in the extinction of plant species by Wm. F. Mahler 191
- The Sterculiaceae in the flora of the southeastern United States by R. David Whetstone 15–23
- The taxonomic status of *Stipulicida filiformis* (Caryophyllaceae) by Walter S. Judd 33–36
- THIERET, JOHN W., Review: National list of scientific plant names 328–332
- THIRET, JOHN W., see Medley 114–122
- Thomandersia* 99
- Thuja occidentalis* 115
- Trichomes and stomata of *Gordonia lasianthus* (Theaceae) by Loran C. Anderson 103–113
- Trifolium lappaceum* 263
- TUCKER, GARY, Richard Harley Davis, 1946–1984, In Memoriam 265–266
- TUCKER, GORDON C., Taxonomic notes on two common neotropical species of *Cyperus* (Cyperaceae) 298–307

- Two additions to the Arkansas flora from Warren Prairie by Eric Sundell 188–189
- Two adventive species of grasses, *Apera interrupta* and *Deschampsia danthonioides* (Poaceae), new to the Ohio flora by Allison W. Cusick and David M. Brandenburg 322–323
- UTTAL, LEONARD J., Nomenclatorial changes, lectotypification, and comments in *Aronia medikus* (Rosaceae) 199–202
- UTTAL, LEONARD J., *Senecio millefolium* T. & G. (Asteraceae) and its introgressants 216–222
- UTTAL, LEONARD J., *Solidago flaccidifolia* Small (Asteraceae) new to Oklahoma and other goldenrod notes 324–326
- Vascular flora of Kentucky: additions and other noteworthy collections by Max E. Medley, Ray Cranfill, and John W. Thieret 114–122
- Verbesina mollis* 25; *sericea* 25; *texana* 82; *virginica* 82
- Veronica hederifolia* 120
- Very personal generic names (*Nomina Perpropria*): A contribution to whimsical botany by Paul A. Fryxell 95–102
- Viburnum opulus* var. *opulus* 120
- Vicia grandiflora* 297
- Viola cucullata* 297
- Vulpia myuros* var. *hirsuta* 260
- Waltheria indica* 18
- WARD, JOHN R., see Nixon 167–175
- WARREN STEVEN D., *Bromus sterilis* L. (Poaceae) new to Texas 257–258
- WHETSTONE, R. DAVID, The Sterculiaceae in the flora of the southeastern United States 15–23
- WIERSEMA, JOHN W., A new species of *Nymphaea* (Nymphaeaceae) from the Amazon Basin 195–198
- Willrussellia* 99
- Willwebera* 99
- Xyris iridifolia* 291
- Zigadenus densus* 291

Barney L. Lipscomb
Herbarium
Southern Methodist University
Dallas, TX 75275, U.S.A.

